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Modern Plant for Kimball Building

HIGH PRESSURE BOILERS, COMPLETE MECHANICAL HANDLING OF COAL AND ASHES, AIR CONDITIONING EQUIPMENT AND MANY AUTOMATIC DEVICES ARE NOTEWORTHY FEATURES OF A NEW CHICAGO OFFICE BUILDING

AT THE SOUTHWEST corner of Wabash Ave. and Jackson Blvd. in Chicago is located the Kimball Building, which is just being completed. It was built primarily to accommodate the growing business of the Kimball Piano Co., but also contains studios of music, concert halls and a large number of offices. The building has 17 floors, basement, subbasement and sub-subbasement. No detail of consequence in a modern office building has been omitted from the equipment of this plant and the architects have provided many features not common in this type of plant.

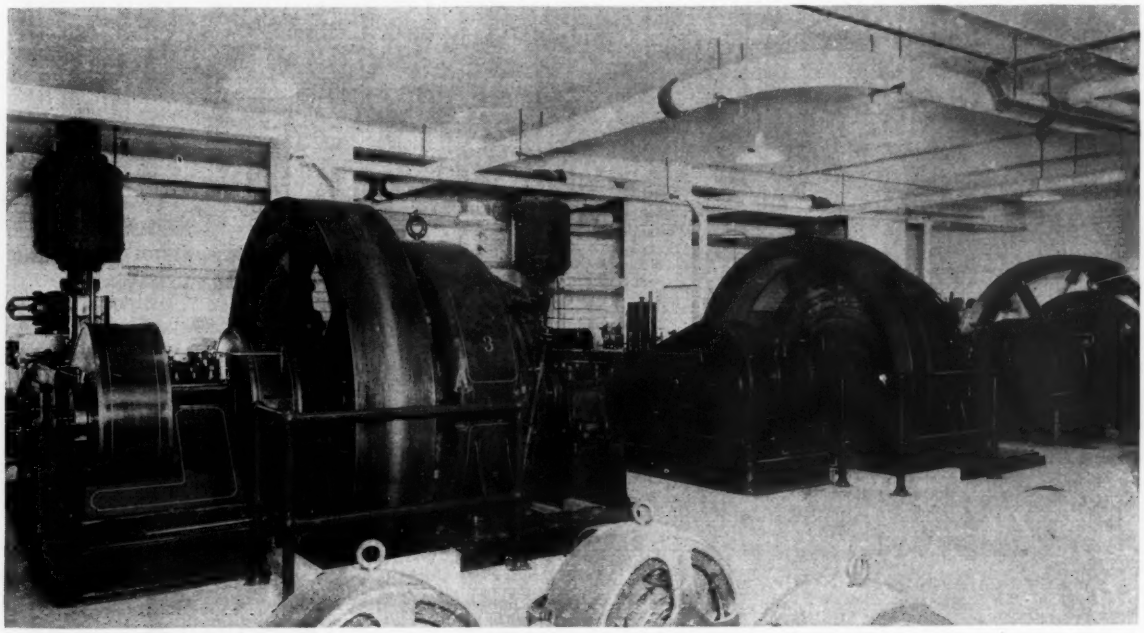


FIG. 1. GENERATING UNITS IN THE KIMBALL BUILDING

COAL AND ASH HANDLING

BEING LOCATED in the sub-subbasement, the floor level of the boiler room is the same as that of the Illinois Tunnel Co.'s track system. The most convenient method of receiving coal is, therefore, in the cars of the tunnel company; but provision is also made for receiving coal in wagons which are unloaded into chutes with openings on Wabash Ave. When the system now under construction is completed the coal will go from the cars to a receiving hopper, from which it will be delivered by a bucket conveyor to the coal storage bin. When delivered in wagons, the coal goes directly to the storage bin. Three openings are left in the hopper bottoms of the coal storage bin, which discharge to the lower run of the conveyor or, in an emergency, to a wheelbarrow on the boiler room floor.

For each boiler a coal hopper will be provided to receive coal from the storage bin, screw conveyors being used to make this transfer. These hoppers are designed for weighing the coal and each is provided with a scale placed at a convenient point for reading from the floor of the boiler room.

The traveling conveyor mentioned above will be of

the pivoted, overlapping, bucket type, arranged to take coal from the receiving hopper and deliver it to the coal storage bin or take it from one portion of the bin and deliver it to another or to the auxiliary conveyors. The capacity of the conveyor is 40 tons an hour, at a speed of 40 ft. per minute. The screw conveyors, three of which will be installed, are to receive coal from the bucket conveyor and deliver it to the coal hoppers, each having a capacity of 15 tons an hour.

Ashes are removed from the pits beneath the grates by a pneumatic system, furnished by the Green Engineering Co., and delivered to an ash storage tank, which is provided with plates to break the fall of the incoming ashes and equally distribute them over the entire area of the tank. Means are also provided for quenching any fire in the ashes before they enter the tank and an automatic device is employed to relieve any accumulated gases from the tank. The tank discharges the ashes directly to a car of the Illinois Tunnel Co., or wheelbarrows.

Boilers

Steam generating equipment consists of three Heine water-tube boilers, each rated at 308 hp. These are arranged in single settings, as indicated in the plan view of the plant; the front support being on a bracket between two columns, while at the rear a steel back stand with roller is employed. This standard method is frequently resorted to in office buildings or places where overhead space is limited.

Two-pass horizontal baffling is employed, as will be noted in the accompanying illustration, with tile surrounding the lower row of tubes for about three-fourths of their length, this arrangement being quite general with chain grate furnaces.

Each boiler consists of one drum, 48 in. in diameter by 22 ft. 2½ in. long, made of ½-in. steel plate with double butt straps, double riveted longitudinal seams and single riveted lap girth seams designed for a working pressure of 180 lb. The water legs are of ⅝-in. steel,

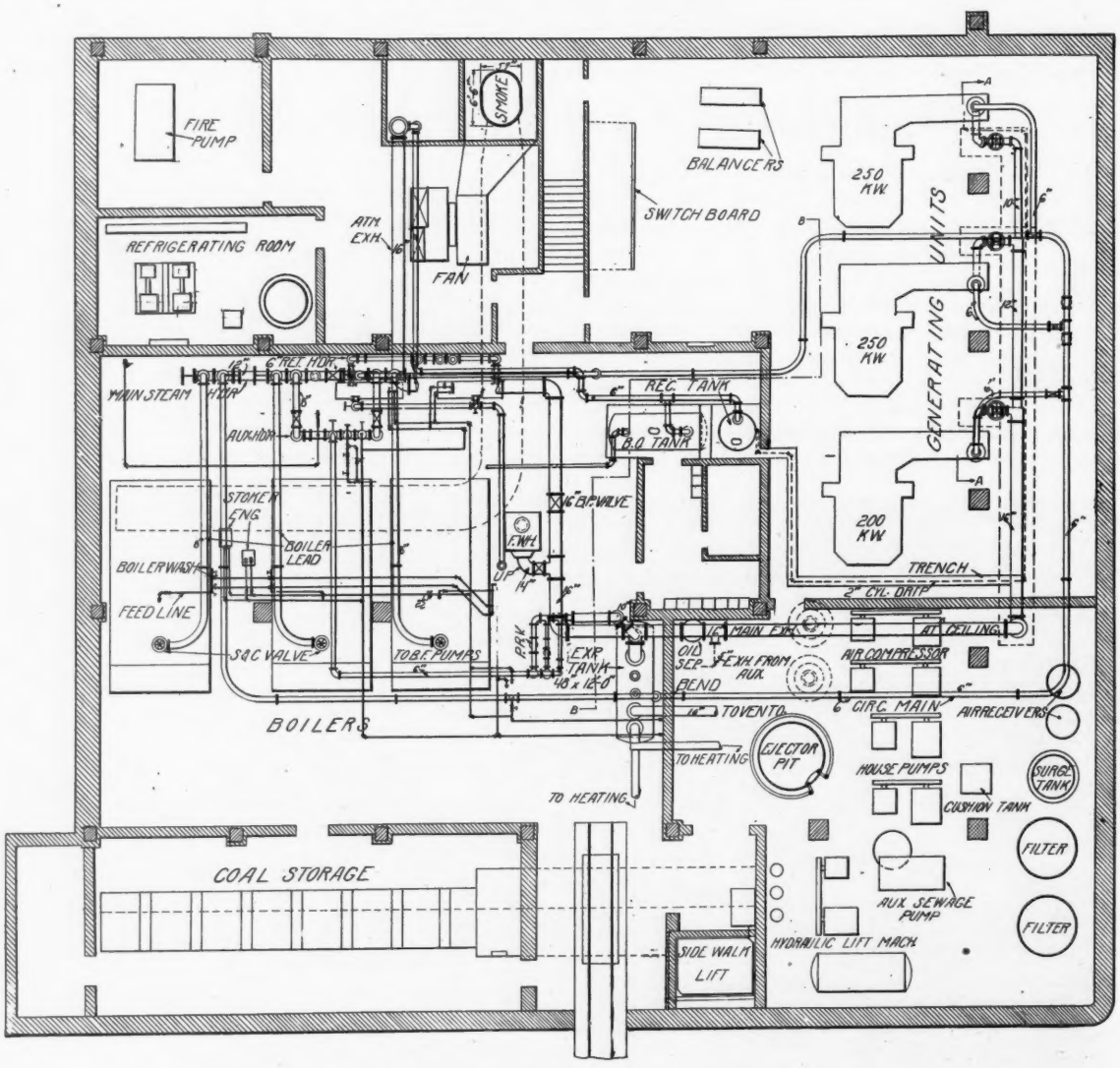


FIG. 2. GENERAL LAYOUT OF POWER PLANT MACHINERY AND PIPING

braced with hollow staybolts, and have inserted in them 176 3½-in. by 18-ft. charcoal iron water tubes. The total heating surface is 3084 sq. ft. Over the front water leg in the drum is a deflecting plate and steam is taken from the front end of the boiler through a dry pipe.

The feed-water pipe passes down through the top of the shell and discharges into a mud drum, from which the water overflows to the boiler drum. Two blowoff pipes, provided with Cadman valves, lead from each boiler, one 1½ in. used to remove sediment from the mud drum; the other 2-in. is called a drain and is attached to the bottom of the rear water leg. Among the principal mountings of the boiler are Reliance high and low water alarm columns, Schaeffer & Budenberg illuminated dial steam pressure gages, two 3½-in. Ashton pop safety valves set for 160-lb. pressure and Bayer soot blowers designed especially for Heine boilers, with horizontal baffles.

Green chain grate stokers with an inclined surface serve the boilers. They are driven by eccentric rods from a shaft running along the boiler fronts, the power being supplied by two Wachs vertical engines, the speed of which is under the control of the Davis damper regulator, thus slight variations in load are automatically taken care of by changes in speed of the stoker engine.

Examination of Fig. 4 will show that each boiler has two uptake connections to the breeching and a damper is placed in each, the positions of the dampers being controlled by the damper regulator, which operates with variations in steam pressure. This arrangement of uptakes and breeching is a noteworthy solution of the problem of limited overhead space. Each boiler is provided with an Eclipse smoke indicator, which is installed in the uptake.

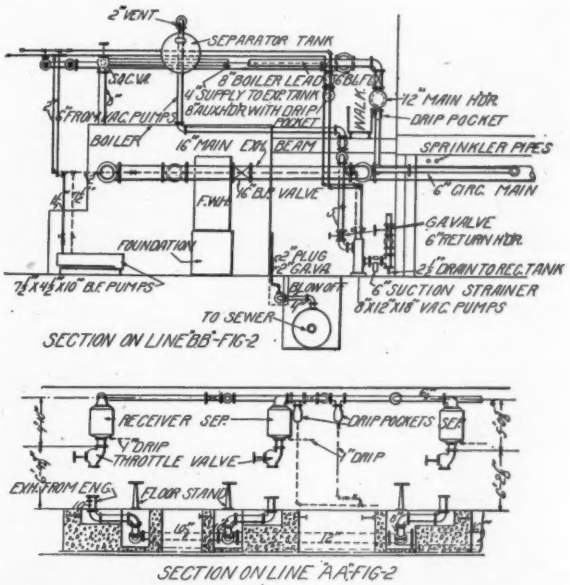


FIG. 3. ELEVATIONS OF FEED WATER HEATER AND ENGINE PIPING

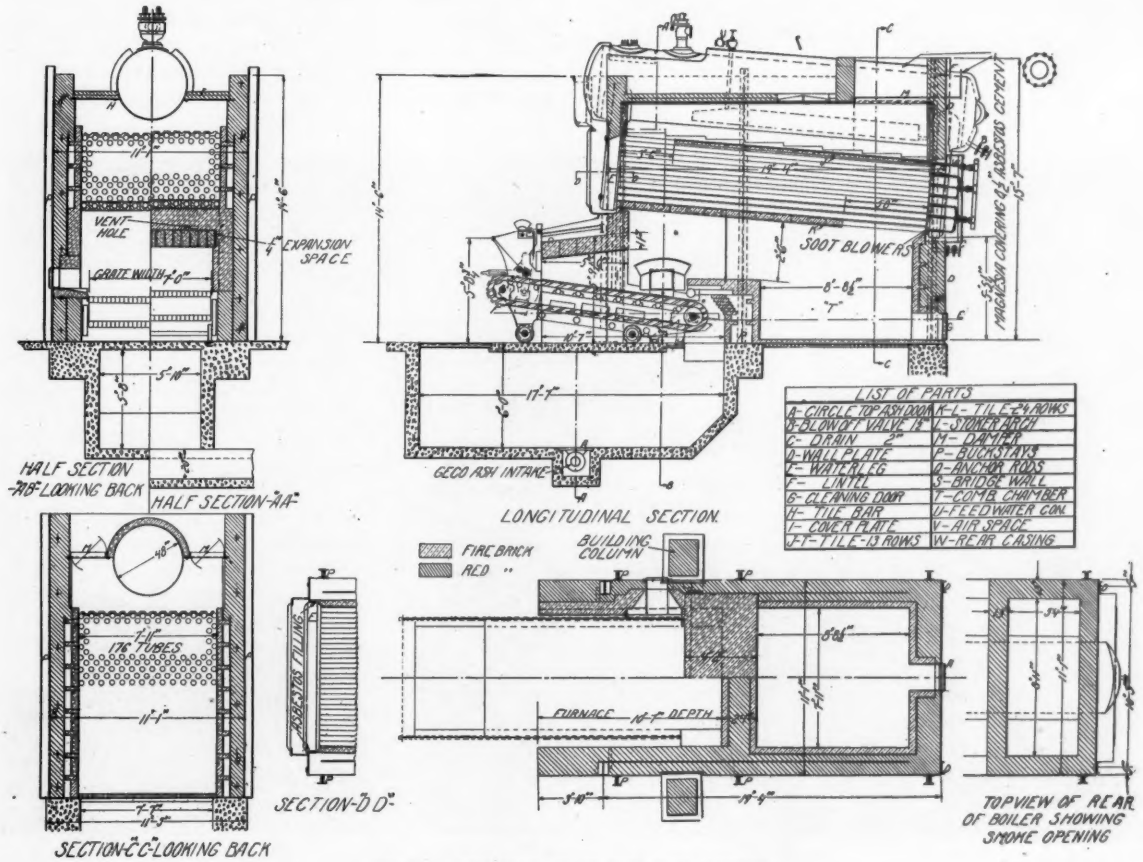


FIG. 4. SETTING PLAN FOR ONE BOILER

Generating Units

Electric current is furnished by 3 units consisting of Ball engines and Crocker-Wheeler generators. Direct current is generated at 230 v. for driving motors and furnishing light on the three-wire system. Two of the units have a capacity of 250 kw. each and the other 200 kw., the speed is 150 r.p.m. and all are provided with flywheels to aid in maintaining constant speed under varying load conditions.

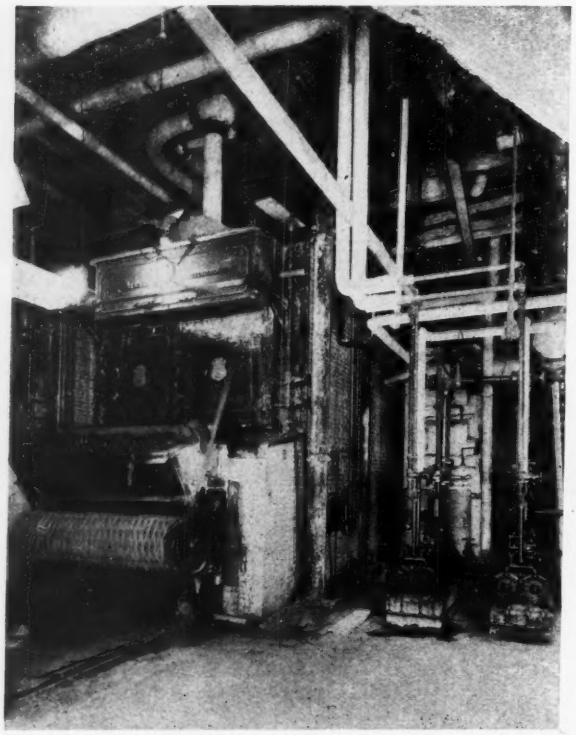


FIG 5. VIEW IN THE BOILER ROOM DURING CONSTRUCTION

The engines are of the four-valve nonreleasing Corliss type, with double eccentrics, which arrangement gives the engines a wide range of capacity and close regulation and rather a flat efficiency curve. One of the interesting features of the units is the oiling system. Each engine has an individual gravity oiling system, which feeds all bearings except the cylinder and valves which are fed by Hills-McCanna oil pumps. This system is complete in itself, being equipped with an overhead reservoir, sight feeders, catch basin, strainer and pump, but is worked in connection with a Bowser oil filtering system except during an emergency, when the station system is shut off by simply turning two three-way cocks.

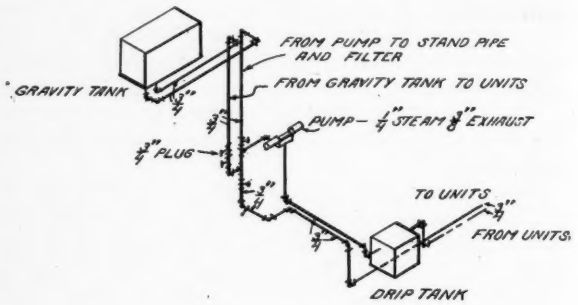


FIG. 6. SCHEME OF OIL PIPING

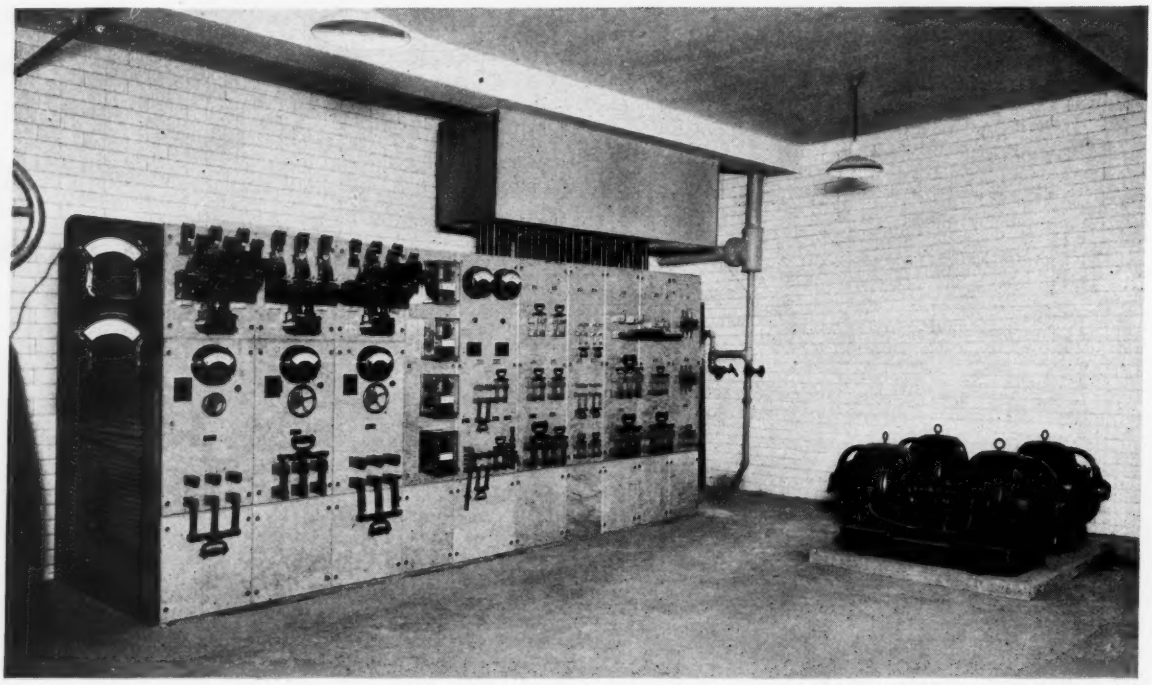


FIG. 7. SWITCHBOARD AND BALANCING SETS

In the central system, all oil drips are pumped from a drip tank, located near the blowoff tank, to a filter near the ceiling of the boiler room. From the filter the purified oil flows by gravity to the machines. In case the filter piping becomes clogged, the pump may be used to reverse the flow of the oil and thus clear the system.

In the engine room are also located two Crocker-Wheeler compensator sets for balancing the load on the two sides of the three-wire system, and the 17-panel station switchboard.

Steam and Exhaust Piping

Steam from the boilers passes through 8-in. Crane stop and check valves and pipes with long radius horizontal bends to the main header. This is divided into two sections by a gate valve. The main steam loop has one end connected to each section of the main header and is so divided by a valve in the engine room that two engines will be on the section of the main header fed by two boilers, and one on that fed by one boiler when both gate valves are shut, giving the flexibility needed when repairs to any section are needed.

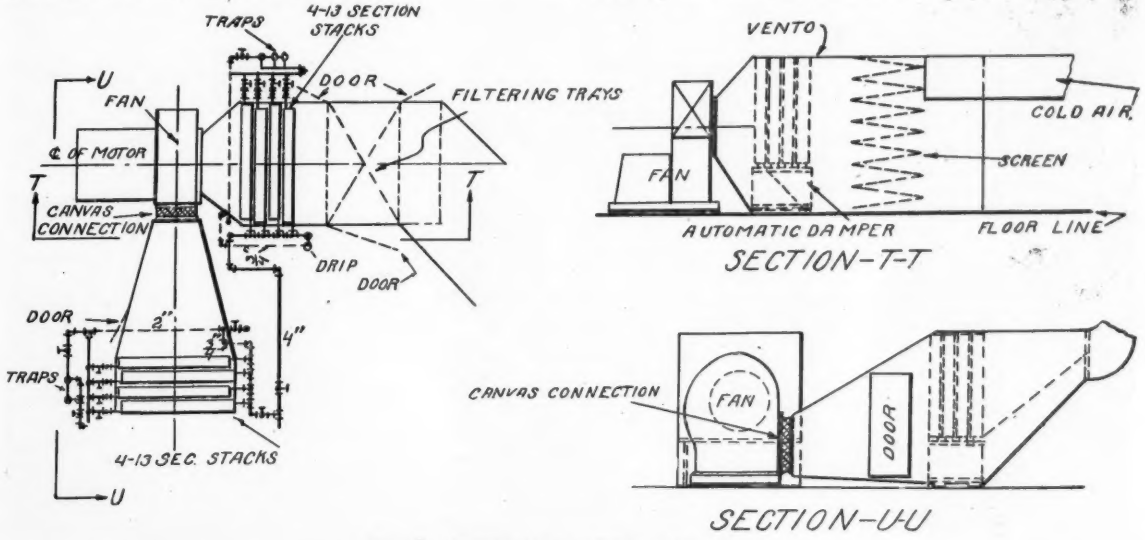


FIG. 8. FRESH AIR FAN FOR ENTRANCES

Connected to both sections of the main header through valves, the auxiliary header carries steam to all pumps, auxiliary engines, heating system and house water heaters when needed. Special provisions, however, are made in the case of some machinery to provide against the possibility of shutdown. For example, the two boiler feed pumps, which are of the outside center packed plunger type, have two independent steam connections, one from the auxiliary header, the other from the steam loop. The house water heaters under ordinary conditions take steam from the expansion tank, but may take direct from the auxiliary header through a pressure-reducing valve. Condensate from these heaters passes through vacuum valves which, however, are provided with a bypass valve and connections to be used in emergencies. Thermostatic control is employed here.

Leads to the generating units are provided with vertical receiver separators and the bends are all made with long radii.

All exhaust steam is carried through an oil separator to the main exhaust, which feeds the expansion tank and feed-water heater by induction connections, surplus being conducted to atmosphere through a Hughson back pressure valve.

To save the heat and water of condensation, a complete system of drip piping is installed. All steam piping is thoroughly protected with drip pockets and drains and the condensate from these is returned by Crane tilting traps direct to the feed-water heater, which is also fed by the condensate from the heating system. Oily drips from oil separators and the like drain to a receiving tank in the same pit with the blowoff basin, from which they go to the sewer. The receiving tank and blowoff basin are connected to the same vent pipe to atmosphere.

All high-pressure piping is covered with 85 per cent magnesia 1½ in. thick; all heating and low pressure piping except distribution in the heating system, with high pressure asbestos molded sectional covering 1 in. thick; supply risers and concealed return riser with ¾-in. wool felt sectional covering, asbestos lined and covered with asbestos sheathing and canvas; feed-water pipes with ¾-in. wool felt; and cold water piping with ½-in. wool felt, covered with insulating paper and protected with a waterproof covering.

Heating System

As mentioned above, all exhaust steam is used for heating the building, feed water or house water. That used in the heating system goes first to the expansion tank, which is also provided with a connection from the auxiliary steam header through pressure-reducing valves, two of which are installed. The 2½-in. valve is used when the minimum amount of live steam is required, the 5-in. valve is used as requirements increase, and when necessary both valves may be employed. All rooms are heated by direct radiation, radiators and coils being operated by the two-pipe Dunham vacuum system.

Supply and return risers are anchored in the fourth and thirteenth floors so that expansion is in both directions from these points with an expansion loop in the eighth floor in all risers except those located in the elevator shaft, these being provided with expansion joints in the eighth floor.

Condensation from the heating system returns to a header, from which it is taken by the vacuum pumps and discharged to a separating tank near the ceiling of the boiler room; it then flows by gravity through a meter to the feed-water heater.

Fresh air is furnished for all basements, corridors and concert halls, both fresh air and exhaust fans being employed. Air coming to all fresh air fans is screened through cloth and, under thermostatic control, is automatically tempered before being delivered to the rooms. In addition, air which goes to the basement, where pianos are stored, is washed and conditioned in order to keep the furniture in best condition. Fan motors are all automatically controlled by a Cutler-Hammer controller, equipped with Cutter Co.'s ITE circuit breakers.

Pumping Equipment

City water is delivered to the building through pressure filters, two of which are installed with piping so arranged that either may be bypassed or the flow through it reversed for cleaning. These feed a surge tank from which house water is taken and delivered to the supply system by motor-driven triplex power pumps.

Compressed air for cleaning generators, motors and other machinery, for which a complete system of piping is installed, and for operating two Shone sewage ejectors, is furnished by two motor-driven air compressors under automatic control. As an auxiliary to the sewage ejectors an American centrifugal pump, driven by a direct connected steam turbine, is installed.

Cooling Water Plant

Cool drinking water is furnished to sanitary drinking fountains located in corridors throughout the building. To cool this water, two compressors were installed by the Frost Maker Ice Machine Co. These are driven by 5-hp. motors, which are automatically started and stopped under thermostatic control, and designed to cool 100 gal. of water from 75 to 40 deg. F. A motor-driven centrifugal pump, capable of delivering 500 gal. of water an hour, keeps the water in circulation so that the temperature in the return main to the tank does not exceed 45 deg. F.

In the cooling water system is an open cooling tank, which has a capacity of 300 gal. The cooling coils placed within are of jointless pipe and the tank is provided with a ball cock and connected to the water supply. The balancing tank has a capacity of 200 gal. and is open to atmosphere having, however, a wood cover with manhole. An overflow is provided to the house tanks, also for return water to the cooling tank.

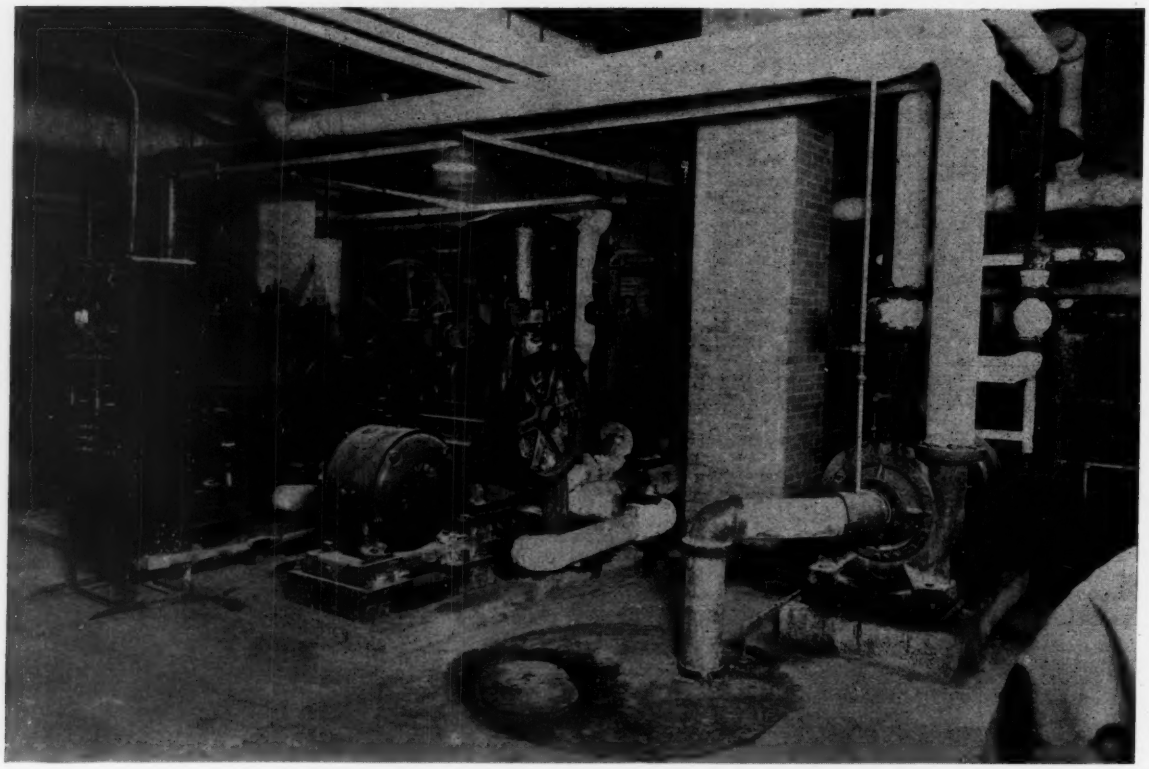


FIG. 9. VIEW IN THE PUMP ROOM

All tanks are insulated with granulated corkboard and paper 2 in. thick; ammonia piping with pitch, 1-in. hair felt, canvas, special cement and 1-in. sectional ammonia pipe covering; drinking water piping with 2 layers of ½-in. sectional wool felt.

Fire Protection

Over the entire building, except over the coal and in the shipping room, where dry sprinklers are installed, a wet-type sprinkler system is provided for protection

against fire, the pressure in which is maintained by a 25,000-gal. circular wooden tank in the top floor of the building, the air being furnished by 2 locomotive-type, steam-driven compressors, each with a capacity of 15 cu. ft. per min. The system is provided with a Siamese connection for fire engines in the street and an Underwriters fire pump in the power plant. The latter starts automatically when a sprinkler head lets go and has a capacity of 750 gal. a min. against a head of 175 lb.

Elevators

One of the most important features of the building is the elevator system, which consists of one combined freight and passenger elevator of the electric 2 to 1 gearless traction type, 6-passenger 1 to 1 gearless traction, one freight electric double worm gear drum type, one hydraulic sidewalk lift, direct-plunger type, and one electric dumb waiter. All of these were installed by the Kaestner & Hecht Co.

PRINCIPAL MACHINERY IN THE KIMBALL BUILDING POWER PLANT

NO. EQUIPMENT	KIND	SIZE	SERVICE, CONDITIONS	MANUFACTURER
3 Boilers	Water-tube	508 hp.	150 lb.	Heine Safety Boiler Works
3 Furnaces	Chain Grate	60 sq. ft.	Steam Pressure Control	Green Engineering Co.
2 Engines	Upright		Drive Stokers	E. H. Wachs Co.
1 Feed Water Heater	Open	32,000 lb. per hour from 45 to 210 deg.	Uses Exhaust Steam by Induction	Harrison Safety Boiler Works
2 Boiler Feed Pumps	Duplex - Plunger	7½ by 4½ by 10	Hot Water from Heater	Worthington Pump & Mach. Corp.
2 Vacuum Pumps	Simplex	8 by 12 by 18	Heating System	Blake-Knowles Works
1 Fire Pump	Underwriters	750 g.p.m., 175 lb. disch.	Sprinkler System	Worthington Pump & Mach. Corp.
2 Compressors	Ammonia		Drinking Water	Frost Maker Ice Machine Co.
2 Motors	D. C.	5 hp.	Drive Compressors	Westinghouse Elec. & Mfg. Co.
2 Engines	Non-releasing Corliss	20 by 27 in.	Direct-connected to Generators, 150 r.p.m.	Ball Engine Co.
1 Engine	" " "	18 by 27 in.	" " " " " "	" " "
2 Generators	D. C.	250 kw.	230 v., 150 r.p.m.	Crocker-Wheeler Co.
1 Generator	" "	200 kw.	230 v., 150 r.p.m.	" " "
2 Balancing Sets	Rotating	5.85 kw.	117 v., 50 amp., 1200 r.p.m.	" " "
1 Switchboard	3-wire	10-panel	230-117 v., D. C.	
2 Sewage Ejectors	Compressed Air	50 gal. per min.	Serves First Floor and Basements	Shone Company
2 Compressors	Air	8½ by 10 in.	Motor-driven, Automatic-Control at 40 lb.	Worthington Pump & Mach. Corp.
2 Motors	D. C.	15 hp.	Drive Compressors	Western Electric Co.
1 Sump Pump	Centrifugal Turbo-drive		Auxiliary	American Steam Pump Co.
2 Filters	Pressure	7500 gal. per hour	City Water Pressure	
2 House Pumps	Triplex, Motor-drive	7500 gal. per hour	From City Mains to 110 lb.	Goulds Mfg. Co.
2 Motors	D. C.	15 hp.	Automatic Control on House Pumps	Western Electric Co.
Heating System	Exhaust Steam	26,000 sq.ft.direct radiation	Vacuum	C. A. Dunham Co.
1 Elevator	Freight & Passenger	1750 lb. at 500 f.p.m.	Sub-basement to Attic	Kaestner & Hecht
6 "	Passenger	6000 " slow		" " "
3 "	"	2500 " at 550 " "	First to Sixteenth	" " "
		1600 " " 25 " "	First to Fourth	" " "
		2000 " " slower		
1 "	Freight, drum type	3500 " " 50 f.p.m.	Sub-basement to Seventh	" " "
		4000 " " slower		
1 "	Hydraulic Lift	2000 " " 75 f.p.m.	Sub-basement to Sidewalk	" " "
1 Fan	Niagara, Conoidal	16,000 c.f.m. at 294 r.p.m.	Fresh Air for Recital Hall	Buffalo Forge Co.
1 "	" "	10,200 " " " 340 " "	" " " lower stories	" " "
1 "	" "	28,800 " " " 220 " "	" " " plant	" " "
1 "	" "	28,650 " " " 280 " "	" " " Sub-basement and basement	" " "
1 "	" "	10,000 " " " 375 " "	Fresh Air for Entrances	" " "
1 "	" "	16,000 " " " 365 " "	Exhaust for Recital Hall	" " "
1 "	" "	29,550 " " " 205 " "	" " Sub-basement and basement	" " "
1 "	" "	5140 " " " 405 " "	" " Toilets & Janitor Closets	" " "
1 "	" "	10,140 " " " 362 " "	" " Kimball Space	" " "
1 "	Turbo "	37,250 " " " 325 " "	" " Plant	" " "

Among the special features of these elevators, which were selected after an extensive series of tests, are the electric motors, which are specially designed and built by the Westinghouse Electric Co., for the Kaestner & Hecht Co. elevators. These are wound for 230-v. direct current and have commutating poles permitting a reverse operation without sparking at the commutators and are capable of withstanding temporary overloads of 50 per cent. Each elevator is provided with a full magnetic controller, consisting of a master car switch to operate electrically, the control magnets governing the direction of motion, acceleration, deceleration and speed of the car.

The cars are provided with a full equipment of safety devices, flash light signals and enunciators.

Graham, Burnham & Co. are the architects, who have had charge of the design of the building and equipment; L. H. Prentice Co. did the contract work in the power plant and Thos. Naughton is the chief engineer in charge of operation; to all of these we are indebted for information, drawings and other aid in the preparation of this description.

"Billie, Do You Believe That?"

By Bud

Jake, the new oiler, had arrived with new overalls, cap, bicycle wrench, etc., a whole outfit, in fact, with nothing missing but the knowledge of the duties of his new job; and of such knowledge he was as innocent as he was of Euclid in all its complexities.

When togged out in the regalia of a Disciple of Antifriction, Jake presented himself before the engineer-in-charge at the desk, who assigned Billie, the composite all-round steam man, to introduce Jake to the oil-filters, tanks, lubricators, etc.

The beauty of tile floors, of polished brass; the silent, rhythmic movements of ponderous units; the mystic yet orderly array of the switchboard equipment, where red and green lights shone gruesomely as if fearful of being seen—all were awakening in Jake the spirit of skepticism. He began to question the accuracy of his organs of sight. Was it all a material reality or the vaporings of an ethereal nightmare fashioned by the subtle subconscious? He would know; he must know! The suspense was all-consuming. Hastily he reached out and grabbed an uncovered steam pipe. Yes; it was real; too real and he was sure of it!

They had now wandered into the presence of a Detroit lubricator, and Jake heard the voice of his Virgil in the person of Billie. The voice seemed lulled and distant in its explanation of the feeder of oil. Jake drank in the words as he would Milwaukee beer on a summer's night. Bill had finished, and Jake stood scrutinizing the miraculous oiler. Finally, looking up at Billie, he said: "Billie, do you believe that?"

Oil-Burning Systems

CHARACTERISTICS OF FUEL; EQUIPMENT REQUIRED; OPERATING SUGGESTIONS. BY H. J. TEIPER

TO make an oil-burning plant complete, fuel pumps, heaters and strainers should be in duplicate and so connected with piping and valves that any one can be stopped or cut out and repaired or cleaned without interfering with the operation of the rest of the plant. The fuel burners are usually made adjustable to the most efficient working for the power used, either individually by internal adjustment or collectively by operating the oil pressure pumps. In most systems, both methods can be used. In some installations, steam is employed for atomizing the fuel oil; in others, air is used for this purpose; but in the most modern and the latest installations so-called mechanical systems are employed. The burners of these are designed to break up or atomize the oil as fine as possible by giving it a whirling motion at the tip or mouth of the burner, accomplished by forcing the oil along a number of flutes or passages in a cone and without retarding its velocity, impinging it onto a finer-angled cone, delivering it from the orifice or burner tip in a fine spray at a pressure of from 40 to 70 lb. per sq. in.

In order to reduce its viscosity to that required for rapid movement through the burner passages and to allow of its issuing from the orifice as a fine spray through the action of centrifugal force imparted to it in its passage through the burner, the fuel oil is heated to from 150 to 210 deg. F., according to its grade. The heavier oils require more heat than the light oils. Heating the oil has also considerable effect on the capacity of the burner. There is a certain temperature for every grade of oil, depending upon the relation between its viscosity and its specific volume. Where its viscosity is reduced to that suitable for atomizing and where the maximum weight of oil can be ejected through the orifice, above this point any increase in temperature reduces the quantity delivered and a reduction of temperature has the same effect. As different grades of oil vary in density, this point can only be determined by actual experience.

Oil heaters contain tubes or coils made of heavy seamless copper or steel, the oil passing through the tubes or coils while the steam for heating it surrounds them. Heaters and coils are usually tested for pressures up to 400 lb. per sq. in.

To heat 300 gal. of crude oil per hour from 50 to 250 deg. F., requires from 15 to 25 sq. ft. of tube heating surface with steam at a pressure of from 60 to 80 lb. per sq. in. Crude oil expands when heated, 1 per cent in volume for every 25 deg. F. rise in temperature. The weight and measurement of oil at different gravities is based on 60 deg. F. temperature and all calculations should be figured from this basis.

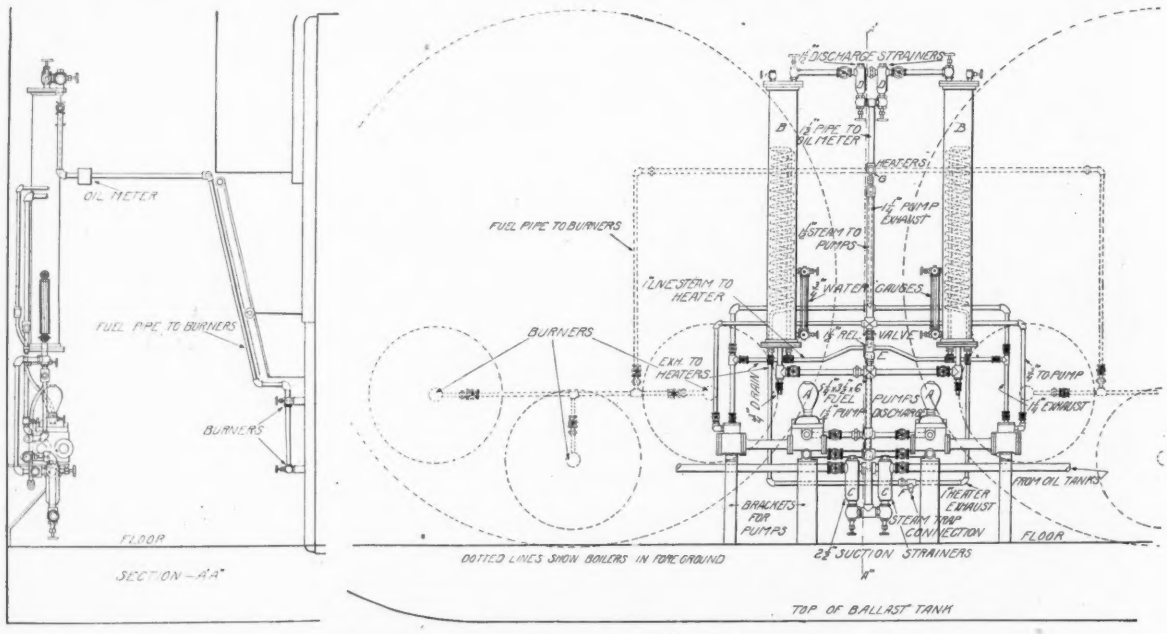


FIG. 1. STEAM ATOMIZING SYSTEM FOR OIL FUEL

If the gravity by the Baumé hydrometer is 10, the specific gravity is 1.000 and the weight per gallon is 8.331 lb. Analysis of Mexican crude oil is as follows: At 60 deg. F. the Baumé hydrometer reading is 19.0; specific gravity is 0.940. Weight per gallon = 7.831 lb., or 9.40 lb. per English gallon.

2240 divided by 7.831 = 286.4 American gallons per gross ton.

2240 divided by 9.40 = 238.3 English gallons per gross ton.

1728 divided by 231 = 7.48 gal. per cu. ft.

38.23 cu. ft. = one ton.

One barrel contains 42 Imperial gallons, and weighs 336 lb.

6.81 bbl. = one ton; 1 bbl. = 5.6 cu. ft.

Carbon, 82.7 per cent; hydrogen, 11.1 per cent; nitrogen, 1.74 per cent; sulphur, 3.35 per cent.

Calorific value = 19,098 B.t.u.

The number of cubic feet per ton of crude oil at a temperature of 85 deg. F. may then be determined in the following manner: Dividing the difference between 85 and 60 by 25 we obtain 1 per cent or 0.01 times 238.3 or 2.383 gal. as the expansion in volume per ton.

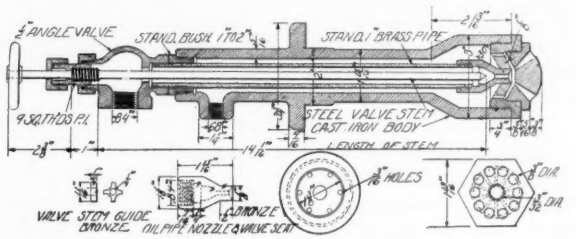


FIG. 2. BURNER FOR ATOMIZING OIL WITH STEAM OR AIR

When the oil is received direct from the refinery stills with the gasoline extracted, it comes out at a temperature of from 130 to 140 deg. F., making these corrections of volume calculations is of considerable importance, as illustrated by the following example:

Let us assume that there are 54,400 gal. of oil received at an average temperature of 134 deg. F. and that it is desired to determine the equivalent number of gallons at a temperature of 60 deg. F.

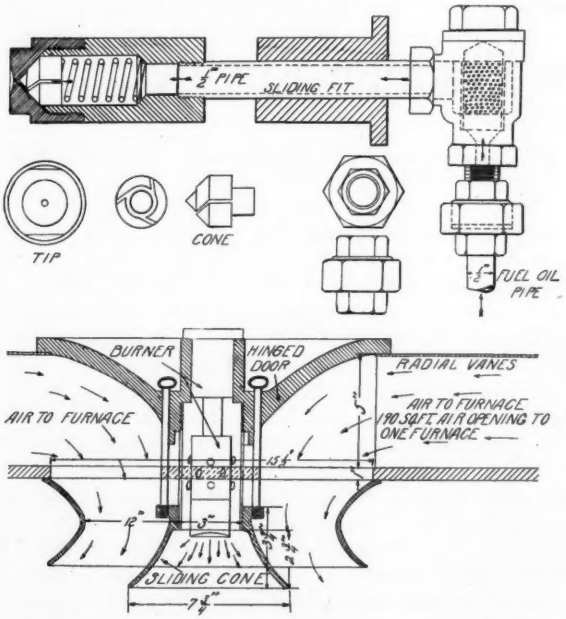


FIG. 3. VIEWS OF LIQUID FUEL BURNER EMPLOYING MECHANICAL ATOMIZER

We then, as before, divide the difference between 134 and 60 by 25 and obtain 2.96 as the per cent expansion. One hundred minus 2.96 is equal to 97.04, the percentage of the volume of the oil when at 60 deg. F., as compared to that at 134 deg. F. Multiplying 54,400 by 0.9704, we have 52,789.7 gal., the volume at 60 deg. F., thus representing a difference of 54,400 minus 52,789.7, or 1610.3 gal., or 38.3 bbl.

The specific gravity of this oil was 0.914,84 at 134 deg. To find the value of its specific gravity at 60 deg. F., we make the following corrections: The difference in specific gravity per degree change in temperature is 0.000,34, so that, with a temperature range of from 60 to 134 deg. F., we have the difference between these temperature values, or 74 times 0.000,34, or 0.025,16, which added to 0.914,84 is equal to 0.940,00. Or, had we known the specific gravity at 60 deg. F. and had we wished to find it at 134 deg. F., we would have subtracted the product of the temperature difference or 74 times 0.000,34, or 0.025,16, from 0.940,000 and have as a result 0.914,84. Since, in this case, the temperature is above 60 deg. F., we subtract; when below the original temperature, we add.

In some oil-burning systems, the air for combustion enters the furnace through open ashpit doors, or openings in the furnace front, without being heated above the boiler room temperature before reaching the burner, which is located in the center of the furnace front.

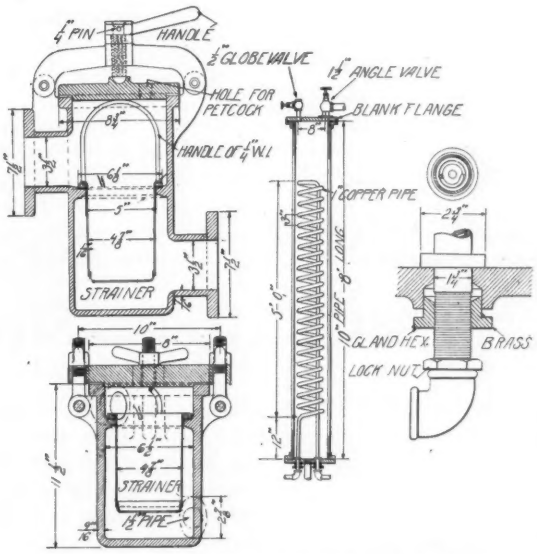


FIG. 4. FUEL OIL STRAINERS AND HEATER

Where induced, or forced draft is used, the air is heated to from 190 to 210 deg. F. by contact with the external surface of the air heating tubes in the uptake, the hot gases from the boiler passing through these tubes on their way to the stack while the air to be used for combustion is drawn or forced into the air heating chamber outside the tubes, when it is heated to the above-mentioned temperature before passing through ducts to the air valves, admitting it to the furnace.

It is important that the air be heated before entering the furnace, not only for the sake of economy but also for the elimination of smoke. In some cases this is accomplished by forming a lining space fitted with radial vanes which conduct the heat from furnace front to the air and a system of cones allows the air admitted around the mouth of the burner to be under complete control and assures a perfect mixture of air and oil, and complete combustion is obtained in the front end of the furnace, the waste gases of combustion leaving the boiler at a temperature of 500 deg. F., and in some instances less.

Only 16 to 18 lb., or about 260 cu. ft. of air per pound of oil are necessary for complete combustion of oil. Experiments prove that not only must there be a relative supply of air to oil consumed, but also that the air must enter the furnace with the oil at a relative velocity. Increasing the supply of air eliminates smoke but any additional air above that necessary for complete combustion results in a waste of fuel. This can be avoided by having a slight amount of brown smoke issuing from the stack.

With proper combustion the flame is a dazzling white for about 6 in. from the jet, when it gradually becomes transparent, then runs into violet, and towards the end changes to red. When too little air is admitted, no violet is seen, the red darkens, and smoke appears. Sometimes with water present in the oil, the flame will show white at the end instead of dark red.

The burners vaporize the oil into an oil gas which ignites and burns close to the tip like a large gas jet.

Admission of air for combustion is regulated by ash-pit doors or dampers in the furnace front, according to quantity of fuel used, which is regulated by speed of fuel pumps according to the volume of steam to be generated.

For best results the oil should be clean and hot; the pressure, to be steady, should be regulated by the speed of the oil pump to suit the load or work required of the boilers.

Plants of 1500 to 2500 hp. usually have two 5¼ by 3½ by 5-in. duplex fuel pumps, while for a 3000 to 3500-hp. plant, two 6 by 4 by 6-in. duplex pumps would be provided.

The pumps generally discharge into a steel air cushion tank or settling chamber for water or dirt; sand and water that precipitates from the oil can be blown off while the system is in use and under pressure.

From the settling tank the oil usually passes to steel heaters with extra-heavy seamless steel or copper tubes or coil having sufficient area to heat the oil 125 to 150 deg. F. with exhaust steam from oil pumps; a live steam by-pass should be fitted in case the pump exhaust is not sufficient to heat the oil to the required temperature. Two oil strainers should be fitted in suction line and two in discharge line between heaters and burners.

All steam and oil connections should be provided with bypasses to insure uninterrupted operation of the plant in case of any part being refitted, changed, or overhauled. All piping, flanges and fittings should be extra heavy and the entire outfit tested at 300 lb. per sq. in. when completed. Pipes to burners should be at least ½ in. in diameter.

A fair average comparison between coal and oil fuel is about as follows: The average boiler evaporates 7 to 8 lb. of water from and at 212 deg. F. per pound of coal, and 12 to 14 lb. of water per pound of crude oil. Three and one-half to 4 bbl. of oil being equivalent in boiler evaporation to one ton of average coal, 36 cu. ft. of oil will give about the same result in heating value as 66 cu. ft. of coal. As a rough estimate, one ton of crude oil will give about the same result as 1½ tons of average coal.

Tests of Unitlow Steam Traction Engines*

By F. W. Marquis

At first thought, it seems strange to find refinements such as the uniflow cylinder and the superheater in connection with traction engines; but when it is remembered that traction engines are used extensively in certain districts (notably the northwestern part of the United States) where fuel is very expensive and water has to be hauled many miles, the reason for taking advantage of every means for reducing coal and water consumption become apparent.

It was, therefore, with a great deal of interest, in the spring of 1915 and again in the spring of 1916, that tests of Baker uniflow traction engines were undertaken by members of the senior class of the Mechanical Engineering Department of The Ohio State University.

The engine tested in 1916 was almost identical with that tested in 1915, except that in 1916 the boiler was supplied with a smokebox-type superheater. The piston displacement of the engine tested in 1916 was 8½ per cent larger than that of the engine tested in 1915 and the water heating surface of the boiler 24½ per cent larger. Both machines were made by the A. D. Baker Co., of Swanton, Ohio.

Principal dimensions of both engines are given in the table. Besides the uniflow cylinder and the superheater, the feature of particular interest is the valve gear. Figures 1 and 2 show cross-sections through the cylinder and valves. There are triple-ported admission valves, and an auxiliary exhaust valve which causes the compression to begin late in the stroke.

Operation of the valves can best be explained by following their movement as the piston moves through one stroke. Suppose the piston to be moving towards the right and nearing the end of its stroke; that is, a little to the left of its position in Fig. 1. The admission valves (top of figure) will then be a little to the right of the position shown, and moving towards the left. The auxiliary exhaust valve *F* (bottom of figure) will be at the extreme right end of its travel, and stationary.

When the edge, *J*, of the piston uncovers the ports at the center of the cylinder, exhaust commences. About the same time the cavity, *A*, in the admission valve uncovers the port at the end of passage *B* and allows live steam to flow from *E* (Fig. 2), through passage *B*, cavity *A* and passage *D* into chamber *N* at the end of auxiliary exhaust valve *F*. This causes valve *F* to move to the extreme left of its travel, closing the auxiliary exhaust port, *K*, and opening the auxiliary exhaust port, K_1. Exhaust is then taking place both through the main exhaust ports and through auxiliary exhaust port K_1. An instant after the auxiliary exhaust valve moves and just before the piston reaches the end of its stroke, admission takes place through the three ports, *C*.

As the piston starts on the return stroke towards the left, exhaust takes place through the main exhaust ports until, early in the return stroke, they are covered by the

*From a paper presented at the Spring Meeting of the American Society of Mechanical Engineers.

piston. The steam still continues to exhaust through auxiliary exhaust port K_1 until the piston covers this port, late in the stroke, when compression starts. Meanwhile live steam has been admitted on the other side of the piston until the admission valve has returned and cutoff has occurred. After cutoff and during expansion, the live steam in chamber *N*, at the head of the auxiliary exhaust valve, is free to expand through passage *L* and do work on the piston. The passage, *L*, enters the auxiliary exhaust valve chamber at such a point that when the valve is thrown some steam is trapped between it and the end of the valve chamber, thus cushioning it and preventing pounding.

Admission valves are driven by a Baker valve gear, which is very similar to the Baker locomotive gear. It is a single-eccentric variable cutoff and reversing gear which maintains equal leads for all cutoffs and in both directions of running.

As used in the 1916 tests, the boiler was fitted with a smokebox-type superheater, consisting of a vertical cast-iron header, into which tubes are inserted, as shown in Fig. 3. Steam enters through pipe *A*, which leads from the steam dome and passes to the front section of the header. It then passes back through the ½-in. pipes and forward through the 1½-in. pipes into the back section of the header. Thence it passes through *B* to the steam chest.

PRINCIPAL DIMENSIONS OF BAKER UNIFLOW TRACTION ENGINES

	Engine used in 1915	Engine used in 1916
ENGINE		
Nominal horsepower	16	18
Nominal r.p.m.	240	240
	In.	In.
Diameter of cylinder	8¾	9¼
Stroke	10¼	10
Diameter of piston rod	1¼	1½
Diameter of flywheel	36	38
Face of flywheel	10	11
Diameter of crankshaft	3	3¼
Length of crankshaft	55½	61½
Diameter of crankpin	2¼	2¼
BOILER		
Number of tubes	40	54
	In.	In.
Outside diameter of barrel	29	32
Length of firebox	36	40
Width of firebox	22¼	25
Diameter of tubes	2	2
Length of tubes	78	72
	Sq. Ft.	Sq. Ft.
Grate area	5.56	6.94
Firebox heating surface	23.6	29.1
Tube heating surface	123.2	153.6
Total water heating surface	146.8	182.7
Superheater heating surface	...	47

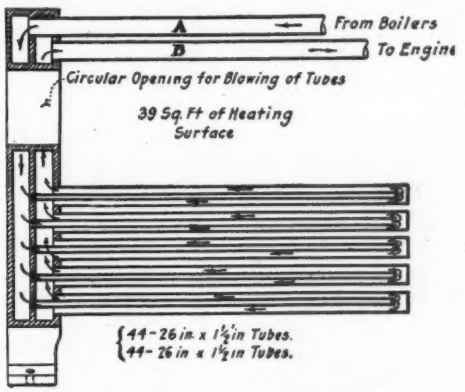
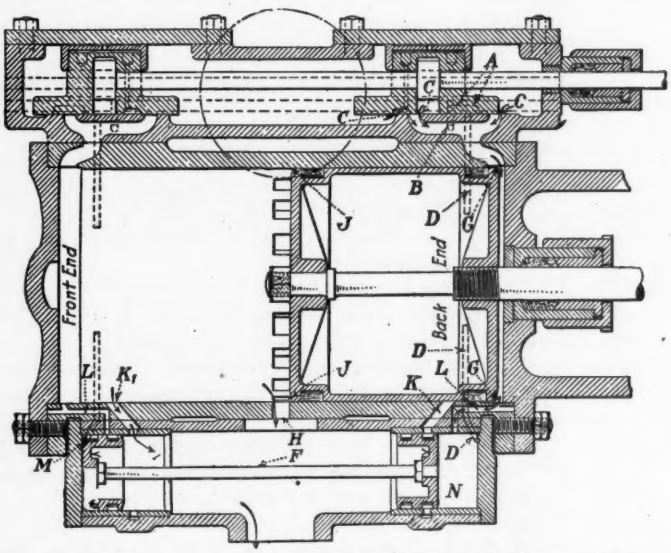
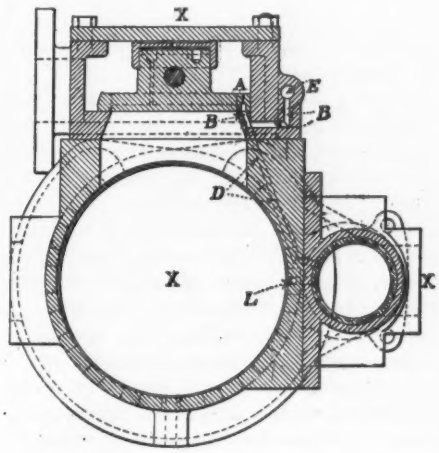


FIG. 3. DIAGRAM OF SUPERHEATER

CHARACTER OF TESTS

IN GENERAL the methods recommended in the A. S. M. E. Power Test Code were followed. The tests were run with the throttle valve wide open, and in general it was attempted to maintain the speed constant at 250 r.p.m. Saturated steam was used throughout the 1915





FIGS. 1 AND 2. BAKER UNIFLOW CYLINDER AND VALVES

series, which consisted of 17 tests with various boiler pressures ranging from 125 lb. gage to 175 lb. gage, and various cutoffs ranging from 6 to 49 per cent. The 1916 series consisted of 17 tests, 13 at 180 lb. gage and 4 at 160 lb. gage. Nine of the former were with superheated steam, and 4 with saturated steam. Superheated steam was used for the 4 160-lb. tests. The cutoff in this series varied from 16 to 75 per cent.

Results

Results having to do with engine performance and with the overall performance are presented graphically in Fig. 4.

In Fig. 5 are two sample sets of indicator diagrams, one with a rather early and the other with a much later cutoff. They show a remarkable lack of wire-drawing during admission, and sharp cutoff for a slide valve engine running at such a high speed (250 r.p.m.). The drop in the early part of the expansion line of the diagrams with an early cutoff, and that in the admission line of diagrams with the later cutoff, is caused by the steam flowing into the auxiliary exhaust valve chamber at the instant the piston uncovers the port leading to this chamber.

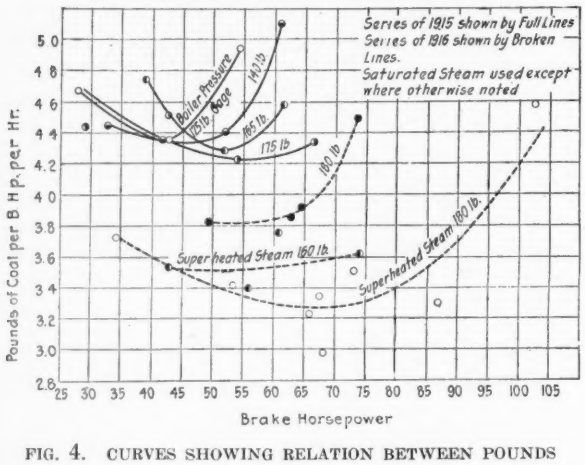

Series of 1915 shown by Full Lines
Series of 1916 shown by Broken Lines.
Saturated Steam used except where otherwise noted
Boiler Pressure 125 lb Gage
149 lb
165 lb
175 lb
180 lb
Superheated Steam 160 lb.
Superheated Steam 180 lb.
Pounds of Coal per B H.P. per Hr.
Brake Horsepower

FIG. 4. CURVES SHOWING RELATION BETWEEN POUNDS OF COAL PER BRAKE HORSEPOWER PER HOUR AND BRAKE HORSEPOWER

Test curves showing the relation between steam consumption and indicated horsepower showed that the highest steam consumption was just under 29 lb., which occurred at 125 lb. boiler pressure with saturated steam and at approximately 60 i.hp. The lowest was 18.2 lb. per i.hp.-hr., in the series of 1916, with 180 lb. boiler pressure and 118 deg. superheat, at about 72 i.hp.

It seems reasonable to assume that the engine should be rated at approximately the point of best economy. On this basis the rating when operating under 125 lb. boiler pressure was found to be 45 hp. Tests were run from about 30 to about 60 i.hp. or from about 60 per cent to 130 per cent of this rated load, and over this range the variation in steam consumption was from approximately 29 to 26½, or only about 2½ lb.

The maximum power obtained was 108.7 i.hp. (102.8 b.hp.), which was secured with 180 lb. boiler pressure and with 181 deg. F. superheat, and with a steam consumption of only 23.5 lb. per i.hp. per hour (24.5 lb. per b.hp. per hour). This becomes particularly interesting when it is remembered that the cylinder diameter and stroke of this engine were only 9¼ in. and 10 in., respectively.

Curves of Fig. 4 show the relation between the pounds of coal used per brake horsepower per hour and the brake horsepower developed.

As a matter of interest from a comparative point of view, the steam-consumption curves of a number of the ordinary counterflow type of steam engines, both simple and compound, noncondensing and condensing, have been plotted on the same sheet with certain of the steam-consumption curves of the Baker uniflow engine. These curves are given in Fig. 6. Information concerning each of the engines whose steam-consumption curve is given in this figure will be found below:

Curve *A*. Simple, slide valve engine, cylinder 8 in. by 12 in., initial steam pressure 130 lb. gage, noncondensing, and at 200 r.p.m.

Curve *B*. Simple, slide valve engine, cylinder 9 in. by 12 in., initial steam pressure 140 lb. gage, noncondensing, and at 200 r.p.m.

Curve *C*. Simple, slide valve engine, cylinder 15 in. by 14 in., initial steam pressure 115 lb. gage, noncondensing, and at 225 r.p.m.

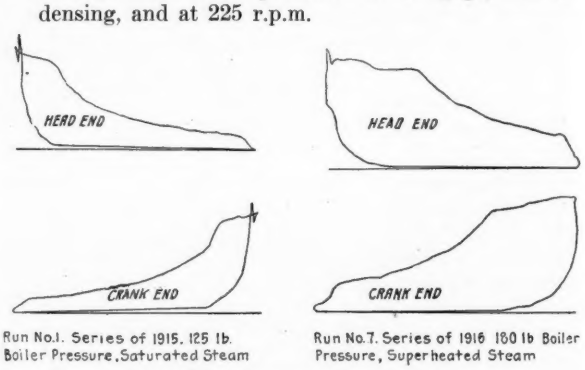

HEAD END
HEAD END
CRANK END
CRANK END
Run No.1. Series of 1915. 125 lb. Boiler Pressure, Saturated Steam
Run No.7. Series of 1916 180 lb Boiler Pressure, Superheated Steam

FIG. 5. SAMPLE INDICATOR DIAGRAMS

Curve *D*. Same engine as in case of curve *C*, but operating condensing.

Curve *E*. Cross-compound, slide valve engine, cylinders 7 in. and 13 in. by 10 in., initial steam pressure 150 lb. gage, noncondensing, and at 310 r.p.m.

Curve *F*. Same engine as in case of curve *E*, but operating condensing.

Curve *H*. Tandem compound, slide valve engine, cylinders 8¼ in. and 13¼ in. by 12 in., initial steam pressure 115 lb. gage, condensing, and at 280 r.p.m.

Curve *G*. Simple uniflow engine, cylinder 8¾ in. by 10¼ in., initial steam pressure 125 lb. gage, noncondensing, and at 250 r.p.m.

Curve *I*. Same engine as in case of curve *G*, but with 175 lb. gage boiler pressure.

Curve *K*. Simple uniflow engine, cylinder 9¼ in. by 10 in., initial steam pressure 180 lb. gage, superheat approximately 130 deg. F., noncondensing, and at approximately 240 r.p.m.

It will be seen that the uniflow-engine curves selected are those representing the poorest and the best results obtained with saturated steam, and the best results obtained with superheated steam.

A study of this set of curves (Fig. 6) shows that the poorest results obtained with the uniflow engine,

namely, those of curve *G*, obtained with saturated steam at 125 lb. pressure, are better than the best results obtained with any of the simple engines, even when operating condensing, and almost the same as those obtained with the compound noncondensing engine shown by curve *E*. Steam consumption of the uniflow engine at 175 lb. pressure with saturated steam running noncondensing is lower than that obtained with the compound noncondensing engine at 150 lb. pressure shown by curve *E*. Also the steam consumption of the uniflow engine with 180 lb. steam pressure and 130 deg. superheat was lower than that of the compound condensing engine with 150 lb. steam pressure shown by curve *F*.

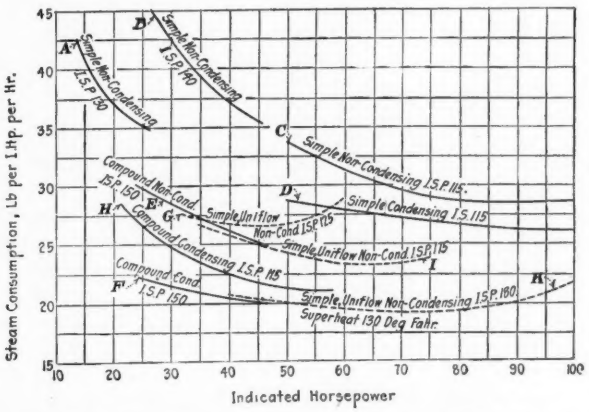

Steam Consumption, Lb per I.Hp. per Hr.
Indicated Horsepower
Simple Non-Condensing I.S.P. 150
Simple Non-Condensing I.S.P. 140
Simple Non-Condensing I.S.P. 115
Compound Non-Cond. I.S.P. 150
Simple Uniflow Non-Cond. I.S.P. 115
Simple Condensing I.S.P. 115
Compound Condensing I.S.P. 115
Compound Cond. I.S.P. 150
Simple Uniflow Non-Condensing I.S.P. 180
Superheat 130 Deg. Fahr.

FIG. 6. RELATIVE STEAM CONSUMPTION OF BAKER UNIFLOW ENGINES AND COUNTERFLOW ENGINES

Thus it is seen that on the basis of the results of the tests and of the information presented by Fig. 6, which is thought to represent fairly the average practice for small simple and compound engines of the older or counterflow type, the simple uniflow engine operating with saturated steam and noncondensing is able to surpass in economy of steam consumption the compound counterflow engine when operating under similar conditions. Also that the simple uniflow engine operating noncondensing but with superheated steam will have approximately the same, or slightly less, steam consumption than the compound counterflow engine operating condensing but with saturated steam.

On the bases of these conclusions, it seems probable that the simple uniflow engine will prove a serious competitor of the compound counterflow type, since it is not only more economical in its use of steam, but also simpler in construction, and therefore probably lower in first cost.

Use of Thermometers to Increase Boiler Efficiency

By H. A. Cozzens, Jr.

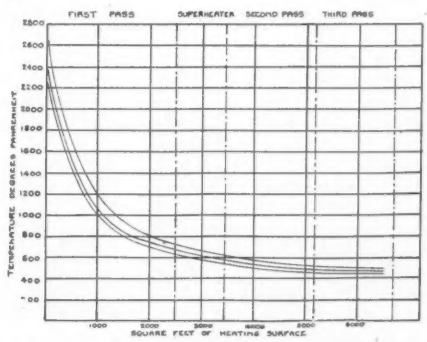
CONSIDERABLE attention has recently been directed on the boiler equipment of power plants with a view of reducing the losses and increasing the efficiency of steam generation. Much has been written on the smokeless combustion of coal. The installation of steam meters and carbon dioxide indicators and recorders, as well as the frequent use of draft gages has been recommended; all these items do their share towards making the boiler plant more efficient. Little mention, however, is made of the importance of installing thermometers in the boiler room and also periodically observing the magnitude of the temperature of the gases as they pass from the furnace to the flue.

There are numerous makes and types of thermometers now on the market which sell for reasonable prices and which, when properly used, will do much to indicate the efficacy of certain methods of firing as well as the operating condition of the various boilers.

Every power plant, regardless of the size, should be equipped with at least one thermometer which may be used to show the temperature of the air outside the plant and also that of the air inside of the boiler room. If a thermometer observation is made of the outside air and then of the air in the boiler room, the difference will indicate the losses due to radiation from the boiler and piping. If no radiation were possible, it is obvious that these readings would be identical. Hence, as this difference is decreased, the efficiency of the boiler rooms will increase. Some very interesting comparisons may be made in various boiler rooms of a large plant equipped with ordinary brick settings and with steel encased settings.

A very interesting study of the heat distribution in a boiler may be made by inserting a pyrometer or thermometer in various locations in the setting in the path of the gases. The most logical places in which to make these observations are at the top and bottom of each pass and at the stack.

The series of curves illustrated in the figure were taken during a number of tests made on a water tube boiler and an underfeed stoker. They illustrate the form of curve, showing the temperature of the gases



VARIATION OF GAS TEMPERATURE THROUGH BOILER SETTING

as related to the passes in the boiler setting. It will be noticed that the temperature decreases abruptly during the first pass, which indicates that the majority of the work of steam generation is done in this vicinity. From there on, the curve gradually drops off until the final temperature is reached in the flue.

The curves are parallel for several changes of rating. This means that the temperature throughout varies almost directly as the temperature of the furnace. For higher ratings, the draft is increased and a greater volume of gases passes through the furnace; but regardless of this, the curve remains of the same form, hence, it may be deduced that the shape of the curve is inde-

pendent of the volume of the gases passing through the boiler setting.

When the characteristic temperature curves have been established for a certain class of boiler, periodic temperature readings can be taken on each boiler to determine the need for repairs. For instance, if observations indicate that the temperature in two of the passes is almost identical and give points not on the curve, it is fairly safe to assume that the baffles are in very bad shape and permit the passage of gases through rather than around the baffle. The thermometer is, in this case, valuable in detecting faulty baffles or leaking settings and indicating the cause for the low steaming ability of a boiler.

The thermometer may also be used to guard the flue temperature which should be maintained in the neighborhood of 500 deg. F. (260 deg. C.). The proper distribution of heating surface and the proper operation of the draft will result in a flue temperature which will be nearly constant. When such conditions prevail, the efficiency of the boiler will be found to bear a relation to the temperature in the fire box, increasing and decreasing as the temperature varies.

These are but a few examples of the importance of having thermometers in use in boiler rooms.

Evaporation*

THE MOST DANGEROUS HALF-TRUTH IN BOILER PLANT OPERATION

A CONSIDERABLE number of plants make a practice of running a series of evaporative tests each year in order to get an idea of how their equipment is working. The unfortunate thing in regard to most tests of this nature is that the data collected is rarely complete enough to permit the direction and extent of the losses to be ascertained, or even the efficiency of operation to be computed. A secondary purpose of such tests is the selection of an economical coal for use during the following year. The net result of the tests is usually "we are evaporating 7½ lb. of water per pound of coal," or "we can evaporate ½ lb. more water with Brown's coal than we can with Smith's," neither of which statements is of any value, for a mere statement of the amount of the evaporation gives no clue to the efficiency of operation or the amount of preventable loss existing in the boiler room. The fact that more water was evaporated with Brown's coal does not necessarily indicate that the efficiency of operation during the test when this coal was used was higher than on that where Smith's coal was being burned, or that Brown's coal is any better than Smith's. Any over-all figure, such as an evaporation figure, merely serves to conceal the intricate interplay of efficiency and economy, and in so doing makes it impossible to discover the points where preventable losses must be attacked if efficiency and economy are to be promoted.

In judging the results shown by an evaporative test, it should always be remembered that fireroom conditions are not constant. The load, draft, quality of coal and the feelings of the fireman are constantly changing, and with a change in one or all of these factors there goes an accompanying change in combustion efficiency. Are you sure that the conditions under which the last evaporative tests in your plant were run were representative of the average daily conditions that hold throughout the year? Was the coal equal to, better or worse than the deliveries you have received since? Did the fireman, knowing that a test was being run, work in his usual manner, or was he out for a record? How would each of these factors affect the results on which you based your decisions? These questions and others like them are of vital importance to the man who chooses his coal or judges of his operating conditions entirely on the results of evaporation tests; for a hot, humid day, reducing the draft to a point where the air supply was more nearly at the proper point, an extra good lot of coal, such as is commonly delivered for the purpose of a test, and a fireman, naturally interested in the sporting element involved in making a good record, will combine to make many a coal produce test results which would indicate a substantial reduction in the annual coal bill, and yet, when the year is over, there is no apparent saving. What is the reason? Were the boilers called on for more steam, owing to an increase in the output of the plant? Did the efficiency of steam production fall off from that shown on the test? Were the deliveries of coal subsequent to the test inferior to that used during the test? Or, finally, did the fireman, after the strenuous day's work on the test, fall back into his easy-going ways for the remaining 364 days of the year?

There is no way to answer these questions unless *all* of the factors involved are *continuously* watched, for it is perfectly evident that the time to stop losses is when they are occurring, and not after the annual coal bill has been computed.

*Taken from a business talk, entitled "The Dangers of Half-Truth in the Power Plant," and published by Fuel Engineering Co., of New York.

THE BUREAU OF STANDARDS has recently investigated a rather unusual and interesting case of corrosion, namely, that of the roofing material of the Library of Congress. The roof of this building has been covered since about 1893 by tinned sheet copper which has become covered, within the last 10 or 15 yr., with small pits; in many cases, these pits have extended completely through the sheet. Such a condition is interesting, particularly in view of the fact that Washington is uncommonly free from smoke, etc., which is ordinarily understood to be a strong accelerating factor in corrosion. The investigation has shown that the corrosion was due to no accidental inferiority of the material, but that it is to be considered as characteristic of all material of this type. It, therefore, appears that tinned copper is not superior in any way to tin plate for roofing material and that in view of its greater cost can no longer compete with it.

Tinned sheet copper is used also for containing vessels such as milk cans and for fittings such as troughs, etc., for soda fountains and breweries. It is probable that such articles would also be subject to pitting corrosion of the same type if they are not worn out by actual abrasion before the corrosion proceeds far. Technologic Paper No. 90, describing this investigation, may be procured from the Superintendent of Documents at 5 cents per copy.

Electrical Machinery and Appliances

For Generating, Transmitting and Using Current

The Federal Capitol Illuminated

AGAINST the sombre shadows of night, at this critical moment in our history, the inspiring white dome of our Capitol at Washington, high above the Federal City, stands resplendent in rays of shining light—a radiant monument to freedom and democracy. The plans for illuminating the Capitol dome were perfected for the recent inauguration of President Wilson and the spectacular results were so satisfactory that the system was made permanent.

Flood lighting was the method used to illuminate the great dome, which is 135 ft. in diameter at the base, 218 ft. high above the roof, and is surmounted by a bronze statue of Freedom. Eighty-four Form L-1 General Electric flood projectors, each equipped with a 400-w. Edison Mazda C flood-lighting lamp, were used. These projectors were placed in four banks, about 200 ft. from the dome, on the corners of the House and Senate wings. By placing the projectors in these positions, it was possible to throw light from different directions on the 36 columns at the base (representing the 36 states in the Union at the time it was designed), and thus eliminate objectionable shadows. Some shadows are desirable to bring out the architectural beauty, but if the shadows are too pronounced they become objectionable.

The building proper was also lighted to a low intensity, to form a setting for the dome and to relieve the contrast between a very light dome and a dark building. The building is about 750 ft. long and 250 ft. wide. The main portion is of sandstone painted white, while the House and Senate wings at the ends are of white marble. Surrounding the building on three sides is a wide concourse bounded by a parapet. Thirty-four Form L-3 G-E flood-lighting projectors, each equipped with a 400-w. Edison Mazda C flood-lighting lamp, were mounted on ornamental posts and placed on this parapet.

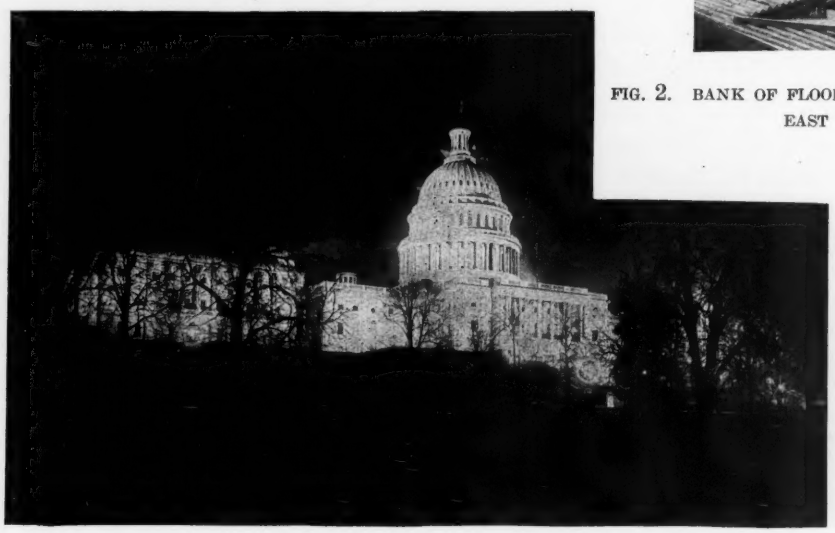


FIG. 1. NIGHT VIEW OF U. S. CAPITOL, WASHINGTON, D. C.

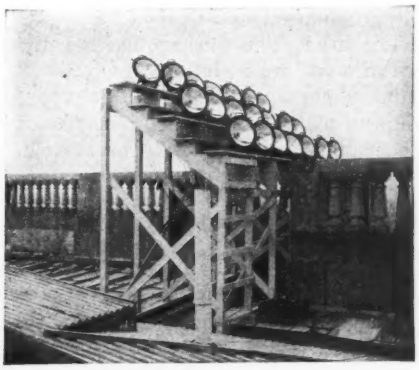


FIG. 2. BANK OF FLOOD LIGHTING PROJECTORS ON ROOF OF EAST WING OF CAPITOL

FIG. 3. G. E. FLOOD LIGHTING PROJECTORS ALONG CAPITOL CONCOURSE

The poles were originally designed to take large opal globes. These globes were removed and blocks of wood were placed in the fitters to which the projectors were bolted. Thus the projectors were inconspicuous and did not detract from the natural architectural features around the building.

BITUMINOUS COAL production for May, 1917, is reported as nearly 40,000,000 tons, which is 7,000,000 tons more than for May, 1916, and 4,000,000 tons more than for April, 1917. Anthracite shipments were also 1,300,000 tons more than for May a year ago. Figures for June show that a still further increase was made for that month.

Labor Data on Underground Cable Construction---I

DEFINITE INFORMATION, VALUABLE IN MAKING ESTIMATES. BY JOHN D. MORGAN

IN THE past decade, underground cable construction has rapidly come to the forefront in the distribution of electrical energy. It is safe to say that in a few years it will be the only method of distribution allowed in cities of 15,000 and over. Many electric companies have already a large department which devotes its entire time to this branch of the distribution system. This method of distribution lowers the number of service interruptions and also aids in the city beautiful idea. This article does not go into the minute details of construction and operation, but discusses only the labor problem and general routine followed in the construction of an underground system.

In underground cable construction the division and subdivision of work are as follows:

Preliminary survey.
Drawing up plans and location of manholes.
Trench, manhole and services. Excavation.
Mixing concrete and setting duct.
Manhole construction.
Trucking reels to and from job.
Rodding duct and installing angle iron racks.
Pulling in cable.
Splicing cable.
Covering cable in manholes.
Breaking through building walls for services.
Installing transformers, pole laterals and junction boxes.
Installing meter protective devices.

In the preliminary survey, a party of at least six men are required, this party consisting of a transitman, front and back rodmen, head and rear chainmen and stakeman. This preliminary survey consists simply of an instrumental examination of the proposed route for the purpose of obtaining such details of distances, elevation and topography as may be deemed necessary to prepare a map and profile of the route. Sketches should be made in the field book of street crossings and all prominent things along the route. Everyone is familiar with the duties of the various men in the party, so no discussion will be made along this line. Such a party as has been described can survey one mile in about 46½ hr. actual working time; this figure takes into account the delays that are generally experienced in surveying through the average city street.

The drawing up of plans and location of manholes is the next progressive step. The location of manholes will require the services of the engineer in charge, for many items must be considered, a few of which are: Location of services, desired lengths of cable, nature of soil, and street intersections. In general, it will be found advisable to locate a manhole every 300 to 400 ft. To draw up the plans properly will take about 36 hr. per mile by a rapid and accurate draftsman.

The actual construction can be begun upon the completion of the plans, and the first step will be the digging of the trench. In the discussion, it will be assumed that there is no pavement on the street, and all labor estimates will be based upon this assumption. Trench excavation is subdivided into 3 distinct operations, namely, digging of trench, caring for surplus, and back-filling.

For trench digging the number of men per gang will be about 37, and will be divided somewhat as follows: 1 foreman, 1 sub-foreman, 2 helpers, 28 diggers, 1 time keeper, 2 watchmen, 1 water boy, and 1 inspector (city).

At this point it becomes necessary to make a few general assumptions which will prevail throughout this discussion:

Soil A consists of sand or loam and is easy digging, a pick being used only once in a while.

Soil B consists of solid earth or hard ground and requires continued use of pick.

Soil C consists of soft shale and can be removed by picking.

Soil D consists of hard shale and requires the use of bar and hammer.

Soil E consists of hard rock and can only be removed by blasting.

Assumed trench size to be 20 by 48 in., or 6.66 cu. yd. per ft. of trench.

Also assumed that general foreman, timekeeper, watchman and water boy will also look after manhole excavation, conduit and service work, but for convenience have included their time in trench excavation only.

With these assumptions in mind the aforesaid mentioned gang will complete the following work in 9 hr:

Item	Soil A	Soil B	Soil C	Soil D
Cu. yd. per digger.....	4.5	3	2.2	1.1
Cu. ft. per digger.....	120	80	60	30
Cu. ft. per gang.....	3360	2240	1680	840
Trench feet per gang....	504	336	252	126
Trench feet per digger...	18	12	9	

If trench excavation requires bracing or sheathing these figures will be slightly reduced or gang made a trifle larger.

In back fill a gang of two men will be required. By back fill, I mean to include in this only the labor of throwing back and tamping. It is assumed that 75 per cent of the excavation will be back fill. This gang of two men should do the following amounts:

Cu. ft. per gang. 500 Soil A 400 Soil B 325 Soil C and D
Trench feet.....100 Soil A 80 Soil B 65 Soil C and D

In manhole excavation the following gang works out very well: sub-foreman ⅛ time, 1 helper, and 2 diggers.

Assuming a standard manhole to be 6 by 8 ft. inside, 8 by 10 ft. outside, and 8 ft. deep (640 cu. ft.), this gang will do the following amounts in 9 hr.:

Item	Soil A	Soil B	Soil C	Soil D
Cu. ft. per day.....	320	288	192	92
Holes per day.....	0.5	0.45	0.3	0.143
Hours per hole.....	18	20	30	63

Removing the surplus is always a difficult problem in all excavation work within cities and in most cases it has to be carted a considerable distance. In general, it will be found that it requires 5 min. for a team to travel a lead of 100 ft. and dump the load, and every additional lead will require an additional one minute's time. Load-

ing dirt into a wagon can be done as follows by one man per hour:

Clay	1.5 to 1.3 cu. yd.
Heavy loam	1.7 to 1.5 cu. yd.
Light soil	2.0 to 1.7 cu. yd.
Sandy soil	2.4 to 2.2 cu. yd.

From the foregoing, the following average assumption can be made, namely, that one team will make an average of 6 trips per day or 12 cu. yd., and that six men will fill a wagon in ⅓ hr., or 54 cu. yd. per day.

In the excavation for services a gang of 17 men is advisable, said gang consisting of 1 sub-foreman and 16 helpers. This gang can in 9 hr. complete the following amount of work, assuming the trench to be 1 by 2 ft.:

Soil A, 1200 trench feet; Soil B, 800; Soil C, 520.

In the back fill of services a gang of two men will be needed, and they will complete about 200 ft. of trench per day of 9 hr.

The labor gang in mixing concrete should consist of 19 men subdivided as follows: 1 sub-foreman, 9 helpers, 8 mixers, and 1 waterman.

In mixing concrete the following duties are assumed: Mixing and carrying concrete to trench or manhole, but not putting it in position. Such a gang as has been described will mix about 18 cu. yd. every 9 hr.

The laying of duct is a more complex item than those previously discussed, and for the sake of convenience and clearness I will subdivide this item into the following subdivisions, namely:

Laying of fiber duct.
Laying of single tile.
Laying of multi tile.
Laying of iron pipe.
Laying of Edison tube.

The laying of fiber tube is assumed to include carting it from storeroom, actual setting, racking concrete and cutting in manhole. This work demands the following gang: 4 helpers, 2 setters, and 1 single wagon. This gang can lay 3500 duct feet each 9 hr.

The laying of single tile duct is assumed to include the carting from storeroom, mixing and spreading mortar, placing of concrete and putting in at manhole. The following gang is advisable for this work: 4 helpers, 1 mixer, 1 setter, 1 double wagon, and 1 helper on wagon. Such a gang can lay 1500 ft. of duct per day of 9 hr.

In the setting of multi tile duct the same labor assumptions are made as in single tile duct. But the gang needed is as follows: 6 helpers, 1 mixer, 2 setters, 2 double wagons and 2 helpers on wagons.

NOTE.—It must be remembered that in the laying of fiber, single tile and multi tile duct that the sub-foreman in charge of mixing concrete also supervises the setting of duct.

The aforesaid mentioned gang will lay about 3000 duct ft. in 9 hr.

In the laying of iron pipe duct the following labor assumptions are made, namely, that the laying of pipe includes setting pipe, racking concrete and cutting in at manhole. Also for convenience, pipe ranging from ½ to 1¾ in. will be referred to as Class 1, 2-in. Class 2, 2½-in. Class 3, 3-in. Class 4, 3½-in. Class 5, 4 and 4½-in. Class 6, 5-in. Class 7, 6-in. Class 8.

For classes 1, 2 and 3 pipe, the following gang is needed: 3 helpers in trench, 1 helper top of trench, and 1 helper raking concrete.

For classes 4 and 5 pipe: 4 helpers in trench, 2 helpers on top of trench, and 1 helper raking concrete.

For class 6 pipe: 4 helpers in trench, 3 helpers top of trench, and 1 helper racking concrete.

For classes 7 and 8 pipe: 4 helpers in trench, 4 helpers top of trench, and 1 helper racking concrete.

NOTE.—It is general custom to have iron pipe trucked by an outside concern to the job, hence no provision has been made in gangs for this trucking. Also the sub-foreman in charge of mixing concrete looks after laying of pipe.

These gangs will in 9 hr. complete the following amount of work:

Item	Cl. 1	Cl. 2	Cl. 3	Cl. 4	Cl. 5	Cl. 6	Cl. 7	Cl. 8
Tons laid...	1	1.9	2.9	2.7	3.2	3.8	5.2	6.2
Feet laid...	1200	1000	1000	700	700	700	700	700

The Edison tube system is a system that is fast going out of service, yet in many places it is the predominating method of underground distribution. In order to supply the labor details, I have made the following assumptions, namely, that laying tube includes tube in trench, connecting and installing coupling boxes, filling with compound and laying plank on top. Carting tubes to job includes loading at storeroom, carting to job and unloading. Junction box labor includes carting, setting and connecting. Service includes laying tube, connecting and installing boxes, installing service box in house but not breaking through building wall.

With these assumptions in mind, the following gangs are necessary for fast and staple work.

Laying tube and services: 1 foreman, 2 splicers, 2 splicers' helpers, 1 compound filler, 2 laying pipe, 1 helper, and 1 single wagon.

Carting tube: 1 double wagon and 2 helpers.

Junction boxes: 1 foreman, 2 splicers, 2 splicers' helpers, 4 helpers, and 1 double wagon.

These gangs can do the following amounts in 9 hr.:

Laying tube, 400 ft. of 2 and 2½-in., and 8 services.

Carting tube, 1500 ft. of 1 and 2-in., 900 ft. of 2½-in., 3 junction boxes.

(To be continued.)

IT IS ESTIMATED that with the huge quantities of supplies and equipment that must be moved for the Government, and the great number of men to be transported, the railroads will be unable to handle all traffic in essentials, let alone carrying nonessentials. Even with every effort to get new equipment, to put old equipment to maximum use, to reduce passenger service to a minimum, there will still be a shortage of railroad facilities.

It is necessary, therefore, to use our inland waterways as much as possible for making shipments, and the Bureau of Foreign and Domestic Commerce has issued a circular letter to 7000 trade organizations urging maximum loading of freight cars, elimination of delays in loading and unloading, and the use of water transportation by barges, boats, scows or lighters wherever possible rather than railway cars.

New barges can be built more easily and quickly than new cars, and do not call for increased waterways, as those now available can carry many hundred times their present traffic.

Some Experiences with Secondhand Engines

OLD MACHINERY AND POOR ARRANGEMENT LEAD TO UNSATISFACTORY RESULTS. BY G. H. KIMBALL

AFFAIRS in the power station were going along smoothly and Richards, the oiler, having just been over the turbines, found the watch engineer in a talkative mood, so he asked him to tell some more of his experiences in the Glendale power station.

Wallace glanced towards an old single-phase generator in the farther end of the engine room and began:

"That old machine reminds me of the way the original builders at Glendale started to equip that plant with engines."

"In what way?" questioned the oiler.

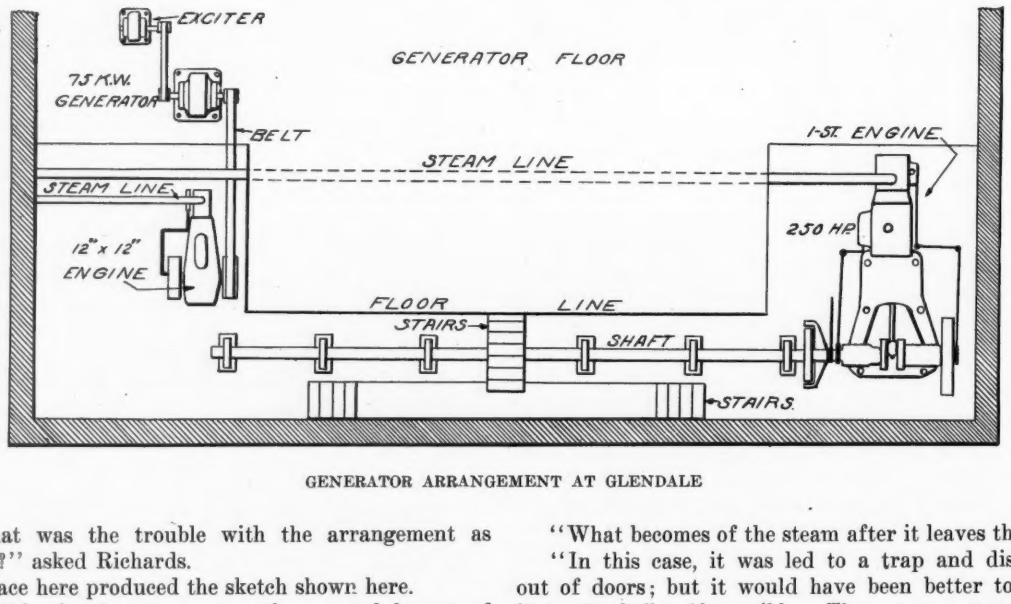
"In the first place," Wallace resumed, "they thought that there was going to be plenty of water throughout the year to generate all of the current required by the cars and lights so that the steam equipment need not be very elaborate. Thus they arranged to connect to each end of the long jack shaft a high-speed engine of about 250 hp. These were to be tandem compound, and they found two that had been in use for street railway work for some years and one of them was installed first."

"First, it had been working hard for a number of years in a street railway plant, and instead of making the conditions favorable, they seemed to go in a directly opposite direction. This was shown by their locating the engine so that it had to run under to correspond with the direction of the shaft motion. Then the engine was built for a speed of about 205 r.p.m., and the shaft ran around 240. Thus, without a condenser and being located 100 ft. from the boiler room, it had considerable of a handicap to start with.

One of the flywheels was removed to make room for the clutch, and if the engine had not been very well made it would not have stood up as long as it did. As the sketch shows, it was center crank, the high-pressure cylinder was steam jacketed and there was a reheating receiver between the cylinders."

"What is that?" asked Richards.

"Simply a reservoir for the exhaust steam from the high-pressure cylinder to flow into, with a coil inside supplied with live steam from the boiler."



GENERATOR ARRANGEMENT AT GLENDALE

"What was the trouble with the arrangement as planned?" asked Richards.

Wallace here produced the sketch shown here.

"In this sketch you can see the general layout of the engine room," he said; "also the location of the first engine and the closeness of the walls. The two spaces at the ends of the shaft are about 8 ft. lower than the generator floor, and you can imagine the distance that had to be traveled in the course of a day for a man to oil up the engines and look after his switchboard and other machines."

"Where were the stairs located?" asked the oiler.

"Just over the center of the jack shaft," replied Wallace.

"Why did the company not install the other large engine as had been planned?" again asked Richards.

"One very good reason," replied the engineer, "was that the first engine was not a howling success."

"In what way?"

"What becomes of the steam after it leaves the coil?"

"In this case, it was led to a trap and discharged out of doors; but it would have been better to deliver it to the boiler if possible. There was a trap on the receiver also that took care of the condensation in the exhaust steam. This arrangement is common with cross compound engines; but with many of the tandem type, there is just a pipe leading from the high to the low-pressure cylinder."

"Did the engineers have trouble in operating this engine?" asked the oiler.

"Yes! considerable, for the man in charge did not exercise the authority that he should and soon all of them had a hand in making adjustments of the bearings which very soon began to cause trouble. Then the oil was filtered and the filter was allowed to get very dirty, so that there were several hot boxes which caused shutdowns; then one day the babbit in the bushing that the piston rod runs through between the cylinders, melted

and ran into the low-pressure cylinder so that there was some heavy pounding going on soon after and they had to shut down for that for some days."

"What caused the babbit to melt?" was a natural question by the oiler.

"The theory is," replied Wallace, "that the load on the station became light enough that the water wheel was pulling the engine. Thus the governor shut the steam nearly off from the high-pressure cylinder and not enough flowed through the low to furnish proper lubrication, and it consequently became hot from the friction of the piston so that the babbit from that end melted and ran into the cylinder. At the time, an attempt was made to get the high-pressure piston off; but it was impossible for the repair force to do so, and after the babbit had been removed, the engine was put together again, but there must have been some leakage of steam through the bushing where the babbit was gone."

"Was it ever possible to get that high-pressure piston off?" asked Richards.

"The next summer," said Wallace, "a man came who had installed the engine in the first place, and when it came time to do that, he inserted a piece of trolley wire in the crank end indicator plug; then, after removing the nut, he had one of us put the friction clutch in on the shaft, and as she went over the center the piston had to come off, as the wire filled up the clearance space."

"That was quite a stunt," commented Richards. "Was the engine ever put in shape again?"

"The man who came, spent some time on it, putting everything in shape," Wallace replied, "but when he tried to get her to run 240 revolutions, she would shut off too quickly and then stay too long before admitting more steam until the speed had dropped too much and the governor jaws would come together with a snap which caused her to hunt, and that could not answer, so the spring was sent to the factory to be stiffened. After it came back it was unsatisfactory and the manager decided not to run it any more than he had to."

"What is this other unit on the opposite side of the room?" asked the oiler.

"It was a 12 by 12 simple high-speed engine," said the engineer, "and primarily it was all right, for it ran in the proper direction and at the proper speed; but the drive was poor and it was apt to slip if loaded too much. This engine had come from the old electric light station and was another well-made machine, so that after some overhauling it was able to do good work."

"Could anything be done to improve the arrangement?" asked the oiler.

"Yes," replied the engineer, "and after I had been there about a year, I persuaded the manager to raise it up to the level of the generator floor, turn it around and run the belt the right way so that it made a good little unit. He also bought a new belt for it, and for some time it was the only means we had of getting lights when the jack shaft was stopped."

"How were the electrical units arranged?"

"It is now time to go over the pumps, so we shall have to leave the matter until some other time."

Richards thanked the engineer and planned to get some further account of his experiences in the near future.

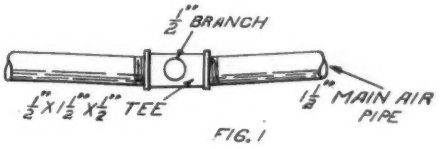
Wasting Air Unnecessarily

By H. A. Jahnke

I HAVE often wondered if some owners, managers and engineers are aware of the amount of compressed air wasted in their plants, due to leaks in pipe and hose connections and carelessness of employes.

I have seen air-hose couplings connected to the main air pipe without any gasket between the joints, resulting in a great waste of air. This also applies to tools connected to the hose, where the joints are not tight, and no attention given the matter until there is trouble; especially is this so where the tools are screwed onto a nipple in the hose. If this joint is not screwed up tight, there is not only the attendant leakage, but also destroyed threads on the nipple and in the head of the tool due to vibration and jarring. It is much better to use some form of hose coupling in connecting the tool to the hose. Where one part of this coupling can be screwed into the tool head the threads in the tool head are not worn out.

In plants where many pneumatic tools are in use, there is generally a cock near the main line in each hose



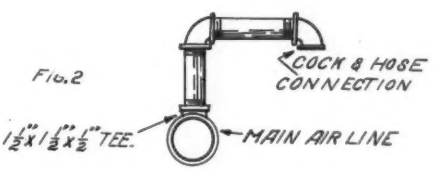


FIG. 1. SAG IN PIPE CAUSING ACCUMULATION OF WATER
FIG. 2. THIS TYPE OF BRANCH CONNECTION REDUCES POSSIBILITY OF CARRYING WATER INTO TOOLS

connection, with another near the tool, thus making it convenient for the operator when stopping the tool for a short time. Many times, however, it occurs that some of the hose is not in use for a number of days, and is left connected to the main pipe, while the cock on the main air pipe is left open and that on the tool end of the hose closed. This is bad practice, as when the air pressure is left in the hose for any length of time, it not only wears out the hose unnecessarily, but should a leak exist, much air will be wasted. It is a little matter to close the cock at the main pipe, thereby shutting off the pressure in the hose, thus saving it and air.

Wasting Air Needlessly

Another bad practice I have seen, which some air-tool operators have, is in stopping a tool; they merely press their fingers over the exhaust opening, a means by which some types of air tools may be stopped. The tool is then left lying this way for some time, the air escaping through the exhaust and needlessly wasted.

I have made it a practice to go through the plant a few times every week to note the condition of the hose, and, if possible, discover any air leaks which may exist.

If there are no gaskets in the hose connections, if any cocks are open which should be closed, or if anything is found wrong, the employer's attention is called to the matter. In this way much air is saved, and tear and wear of the air compressor avoided.

Leaking Air Cocks

It is the practice in some plants to use any old cock or valve for shutting off air on a tool, hose or pipe, or allow the cocks that are in use to leak badly, wasting more air than is used for actual work. This is also bad practice. It takes little time and work to grind a cock so it will not leak, and it is worth while and pays in the long run. In our plant we use at the main air pipe ½-in. hose branch cocks of the spring-key type, which I find give better service than the ordinary key or plug cocks. This type of cock is self-adjusting in case of wear, thereby giving longer service without repairs. I have found where ordinary cocks are used, should the key get loose from wear, and will not stay open or closed, the operators will try to adjust them, and generally getting the key too tight, will try to open or close them with a wrench, or breaking off the handle and making the cock useless. Trouble of this nature may be overcome by using spring key or plug cocks. At the tool end of the hose we use ordinary ¼-in. tee handle air cocks to stop the tool for a short time, and if one leaks a little from wear, it is replaced by a new one that has been repaired.

Sag in Air Pipe

At one time a tool user complained that he had more trouble with water in the air than others taking air from the same line. In looking up the matter, a sag was discovered, caused by crooked threads either in the fittings or pipe, at the hose branch as shown in Fig. 1, where water would accumulate. When this was made right, there was no more trouble.

I have found it a good idea to arrange the hose branches in the main air pipe as shown in Fig. 2, when there is not as much danger of getting water into the tools as where the opening is at the bottom or side of the pipe as is usually the case; as the water is on the bottom of the pipe it can be drained out as necessary.

The manager of a large cement-making plant in Italy wishes to buy machinery and equipment used in plants for this industry, including motors, engines, boilers, and the like. Quotations may be made f.o.b. New York, and payment will be made by cash against documents at the time of shipments, to be presented to the Banco di Napoli, Broadway and Spring St., New York. Correspondence should be in French or Italian, and references given. Full particulars may be obtained from the Bureau of Foreign and Domestic Commerce, Washington, D. C., referring to Item 24,796.

Oil statistics for May, 1917, show a gain in May over April of oil moved from the field sources, but some loss over May, 1916. Deliveries to customers were greater in May than in April and decidedly greater than for May, 1916. In some fields there was a slight increase in stock accumulations, but in others a decrease, the net being a slight increase.

Adoption of A. S. M. E. Code

REPORT from the American Uniform Boiler Law Society on activities since January states that in New York the Code Committee has formally adopted the A. S. M. E. Code, and reported it favorably to the Industrial Commission, and that this report has been acted on favorably by the Commission, to be effective July 1, 1917, and for new construction, Jan. 1, 1918. This is particularly gratifying, as the Code Commission has made a thorough canvass of the state, getting criticisms and comments, and has held meetings in the principal cities of the state, so that the adoption of the Code may be considered as an endorsement by all interested parties in the state of New York.

In Michigan, the act permitting the adoption of a code has been passed, and it is understood that the A. S. M. E. Code will be adopted by a committee to be appointed by the governor. Great assistance has been rendered in the Michigan work by J. C. McCabe, Chief Inspector of Steam Boilers for the city of Detroit; by Professors M. E. Cooley and Bissell, and by E. H. Fisher, of the Wickes Boiler Co., Saginaw, Mich.

New Jersey has likewise adopted an enabling act, and a committee has been appointed, and in due time New Jersey will issue the Code and the date of its going into effect. The cause has been greatly helped by Col. Lewis T. Bryant, Commissioner of Labor.

Minnesota has issued notice through its duly appointed inspection board that on and after Jan. 1, 1918, all boilers must be made according to the A. S. M. E. Code. Much credit is due to Max Toltz and Oliver Crosby of St. Paul.

In Missouri, the enabling act failed for political reasons, but St. Louis and Kansas City have adopted the Code and put it in operation.

The enabling bill was introduced in other states, but failed to pass for various reasons. In no case, however, was the defeat on the merits of the bill, but largely because of political controversy or other interests which side-tracked the consideration of this bill.

In Canada the province of Manitoba is revising its boiler code, and expects to call a meeting in the near future for the purpose of getting co-operation of other provinces in Canada, a desire being expressed to make the A. S. M. E. Code standard, and this movement has the strong support of the province of Ontario, and of leading boiler manufacturers throughout the entire Dominion.

In Massachusetts the Code has not been adopted, although it was hoped that this might be done. The Board of Boiler Rules of Massachusetts has asked various states which have adopted the Code to accept Massachusetts boilers; but when these states asked for reciprocity, it was denied, so that although other states were, as a rule, favorable to admitting the Massachusetts boilers, they did not give the permission requested on account of lack of reciprocity.

States and cities in which the Code has now been adopted, or is in process of adoption, are as follows: New York, New Jersey, Pennsylvania, Ohio, Indiana, Michigan, Wisconsin, Minnesota, California, Kansas City and St. Louis, Mo.

LETTERS DIRECT FROM THE PLANT

Cash Paid For Ideas Accepted. Sketches Desirable.
We Make The Drawings

Improving the Oiling System

I HAVE a 16 by 30-in. long range noncondensing Corliss engine running at 150 r.p.m., and the oiling system was certainly to be condemned. All the oil that returned from the engine emptied into an open tank (A, Fig. 1), with nothing to separate the water from the oil or filter it, and from here it was pumped into a storage tank entering from the bottom, as at B. This tank was half filled with water and the oil was supposed to pass up through this water and then back over the engine as at C. Our problem was to get an oil that would separate from the water as quickly as it entered.

To overcome all this trouble, I have changed the system as follows: In the first place, I made an oil filter out of the receiving tank, as shown at A, Fig. 2, and from the top of the storage tank, as you will note at B; the gage glass was removed to C and a hole was drilled and tapped for the engine feed at D. The water was done away with and the oil is now where the water used to be. Where the oil was I put in coke as at E.

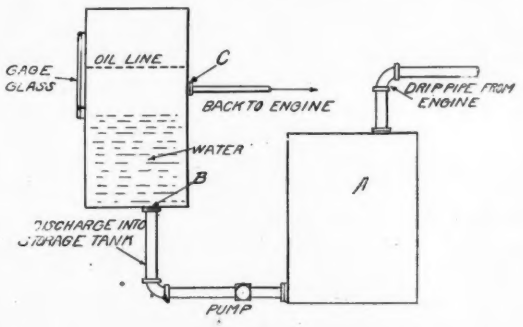


FIG. 1. DIAGRAM OF OLD OIL CLEANING SYSTEM

This system has been operating this way for one year with the same barrel of oil that was put in when the system was changed over and by the looks of the oil, it will be another year before I add more oil.

WM. C. FUNK.

The Water-Tube Boiler a Safety Boiler

THAT THE water-tube boiler is indeed a safety boiler was amply shown by an incident that occurred in one of the plants of an ice and cold storage company in our town. The boiler in this case was one of three 350-hp. Babcock & Wilcox boilers connected to the same steam header. The incident took place during the night watch, at a time when the load was light and one boiler alone sufficed for the work, the other two being cut off from the line.

It appears that about two o'clock in the morning, there was an explosion of the glass water-gage. After inserting a new glass and opening the valves at top and bottom, the engineer noted a water level at about half the height of the gage. What transpired immediately following this event is involved in doubt. Whether the engineer himself, in a moment of abstraction, again closed the valves, or someone else closed them, unknown to the fireman, directly after the engineer had left the boiler room, is open to question. In any case both valves were found closed when subsequent developments directed attention to the anomaly of a glass gage standing half full of water after all the water had been boiled out of the boiler.

About 4:30, the pointer of the pressure gage began to manifest a persistency in receding from the 150-lb. mark close to which it had previously been standing. The fireman livened up the fire a bit, but still the pressure continued to drop. Puzzled and somewhat alarmed at

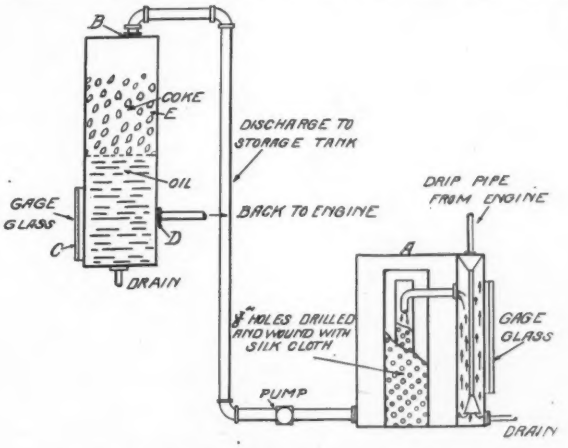


FIG. 2. METHOD OF CLEANING OIL NOW EMPLOYED

the strangeness of it, the fireman increased his stoking activities and presently had the furnace warmed up to a heat that would ordinarily have sufficed for overload work.

When the pressure had dropped to about 30 lb. the engineer's attention was aroused by the laboring and slowing down of the engine. Running into the boiler room, the first thing he noticed was the two gages of water in the glass; also, he observed the very brisk fire in the furnace. Mystified with the queerness of it all, he was at a loss to know what ought to be done; but by way of doing something, he ran back to the engine room to take a look at the feed pump, which had been rigged up for automatic control in connection with a feed-water regulator. He found the stop valve in the steam pipe to the pump closed tightly. He opened this

valve; the pump made a couple of strokes, and then came the finish.

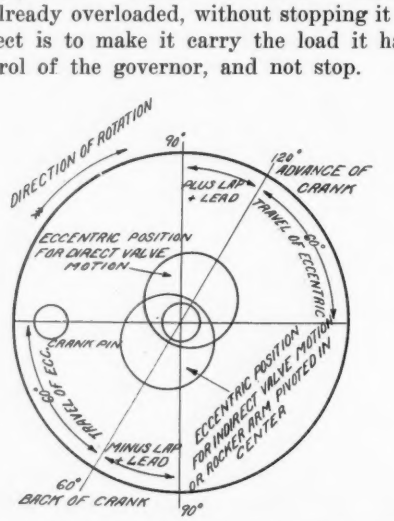
It was a mild explosion; in fact, it wasn't exactly an explosion at all. There was not enough water there to make a respectable explosion; not enough even to deaden the fire. It is probable that the tubes in the bottom row were fast acquiring the condition of a welding heat when the engineer started the pump. At any rate, with the first dash of water sent in, there was a cracking sound, a puff of steam in the furnace and each of those bottom-row tubes opened out as flat as a flounder for about 4 ft. of its length. Every tube in the boiler was burned, but the drum escaped damage.

Truly is the water-tube boiler a safety boiler. Truly also, is the fusible plug not always a dependable safety device.

A. J. DIXON.

Making the Corliss Engine Do More Work

THE ANSWER given by Mr. Aldrich on page 284 of the March 15 issue in reply to the question, "With steam pressure and speed remaining the same, how would you make a Corliss engine develop more power?" appears to me to cover but about half the ground. J. C. Hawkins, however, on page 482 of the June 1 number, has explained fairly well the points at issue, except omitting the real answer which might be desired and required by an examiner. Mr. Hawkins says, "add more load," but how can more load be added to an engine already overloaded, without stopping it entirely? The object is to make it carry the load it has, under the control of the governor, and not stop.



POSITIONS OF ECCENTRIC FOR INDIRECT VALVE MOTION OR WITH ROCKER ARM PIVOTED IN CENTER, AND DIRECT VALVE MOTION

If the speed is to remain the same, why change the governor? It is set to maintain constant speed. If it is set to cut off as late as possible in the stroke, then it will shorten the cutoff as the load decreases and prevent the engine from running away. The average length of cutoff on a Corliss engine with a single eccentric is about 2/5 stroke, and with a double eccentric, ½ stroke. This is the general limit of the governor action, and as Mr. Hawkins has explained, the eccentric would have reached the point of extreme throw and would be on its return travel, thus closing the valve if it has not already tripped, instead of opening it further and making the engine act the same as a plain slide-valve engine. The governor could do no more than set the cams to hold the latch hook on the block and prevent the valve being closed by being tripped. The eccentric would then close the valve.

Mr. Aldrich suggests giving the engine a later cutoff by changing the steam and exhaust rods which connect the valve cranks with the wristplate. But this is not all.

Mr. Hawkins did not mention the steam rods to the wristplate, while Mr. Aldrich failed to mention the eccentric. These are the two points I want to bring together. Both the position of the eccentric and the length of the rods connecting the wristplate to the bell cranks on the valve stems must be changed. For this reason, to obtain a cutoff later than that mentioned before, you must place the eccentric back of its present position of 120 deg. in advance of the crank, to nearly 45 deg. in advance of the crank.

Now, in this position, the valves of a Corliss engine having but one eccentric and one wristplate would be in a bad tangle. But on a double eccentric Corliss engine with two wristplates only the steam eccentric would require shifting and the steam valve rods changed. This cannot be done while running, and in some instances new rods must be made, while in other cases all that is required is to extend the length of the thread about an inch. So with the crank on the center, the steam valve could be opened enough by these rods to uncover the lap of the valve and give it the correct amount of lead; this is with engines having rocker arms, pivoted at one end, and direct acting valves. With rocker arms pivoted in the center or indirect valve action, it will be noticed by careful study that the eccentric is back of the crank and the amount of lap and lead nearer to the crank; that is, instead of the eccentric being 90 deg. plus the lap and lead ahead of the crank, the eccentric would be 90 deg. minus the lap and lead or about 60 deg. back of the crank in order to open the valve.

The question applies not only to the Corliss engine, but to all high-duty 4-valve engines. The Green or Green-Wheelock engine pushes open the valve on one end of the cylinder and pulls open the valve on the other end; the Rice & Sargent Corliss engine is patterned after the Green in the way of operating the steam valves. Both of these engines, by pushing and pulling open the valves, have indirect motion, hence the eccentrics are back of the crank, minus the lap and lead nearer to it. See the accompanying illustration.

R. A. CULTRA.

Foundation Trouble

AFTER SEVERAL years of operation, 2 engines employing the enclosed crank case and splash system of lubrication began to give trouble due to excessive vibration. The nuts on the foundation bolts were tightened frequently, giving little relief. Finally the condition grew so bad that the rear end of the bed plates could be seen to jump from the foundations at each stroke, and tightening the foundation nuts resulted in a burned wrist-pin bearing and excessive heating of the out end of the cap on the outboard bearing of one of the engines. It

was realized that the engine had been thrown out of level, and to prevent further trouble it was decided to regrout the rear end of the engine (the front end not being affected).

After loosening the nuts on the foundation bolts, the old grouting, which was not over 3/8 in. thick, was scraped out from under the bed plate. It was so saturated with oil as to be readily crumbled in the fingers despite the fact that considerable care had always been taken to prevent any accumulation of oil on the foundation. After removing the grouting the cement foundation was chipped away with hand drills until good solid concrete was uncovered. This left a space over an inch in depth extending 5 or 6 in. under the bed plate at the rear and on either side up to a point opposite the forward end of the crosshead guides. Next, a couple of wedges were driven under the plate until a level showed the main bearing to be a shade high, then a grouting composed of equal parts of good sharp sand and Portland cement with the addition of about 5 per cent of ironite or iron cement was mixed and poured, using forms high enough to bring the surface of the grouting well up over the flange of the bed plate.

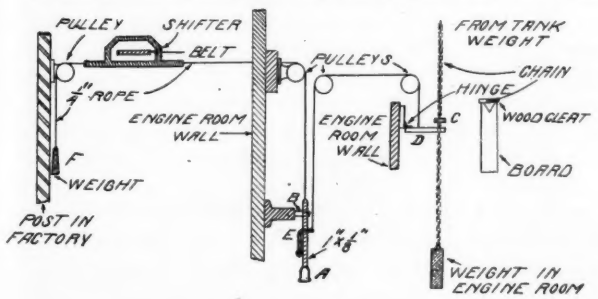
After 3 days the wedges were removed and the holes filled with the same material. The entire surface of the new grouting was given 3 heavy coats of a good oil resisting paint containing a small portion of litharge. After the foundation bolts were tightened, the engine was found to be level and all movement between the foundation and bed plate had disappeared. The other engine was then given a like treatment with equal results. Although some oil still collects on the foundation, the paint and hard surface due to the use of iron cement have effectively resisted it.

This work was done by the regular engine room force, the only extra expense being that of the material used.

A. C. McHugh.

Automatic Belt Shifter

We have a vertical belt-driven deep well pump in our plant which is used for pumping water into a tank from which water is used throughout the factory. When I took charge of the plant I found that there was an automatic belt shifter to stop the pump when the tank



ARRANGEMENT FOR SHIFTING BELT AUTOMATICALLY

was full. The apparatus was installed by some former engineer in charge of the plant.

It will be noticed that the pump is located in a part of the building next to the engine room. When the pump is to be started, the belt is shifted to the tight pulley by the handle, A, which is located in the engine room. Into this handle a small hole is drilled which goes over the pin, B; then the handle is held in position by this pin. When the task is nearly full, the collar, C, which is clamped over the weight chain from the tank, presses down on D, thereby lifting E, which releases the shifting handle from pin B, when the weight, F, on the belt shifter in the factory will shift the belt onto the loose pulley. Of course, this arrangement of the weights pulleys, ropes, etc., would not do in many plants; but they can be changed to suit conditions in the location.

H. A. Jahnke.

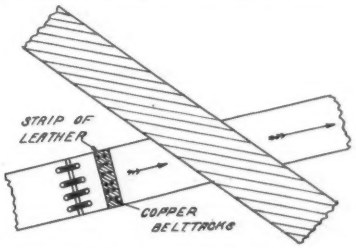
Heat Resisting Covering

Inexpensive tubing for electrical wires can be made in the following way: Coat a straight brass or iron rod heavily with melted paraffine and allow it to cool. Then mix one part of plaster of paris and 2½ parts of water, adding a small quantity of lime. Tear muslin strips 1 in. wide and dip into the mixture. After allowing them to absorb all they will hold, wind them smoothly around the rod, working slantwise from end to end. Enough layers may be applied to give the desired thickness. When the plaster is thoroughly hardened, heat the metal core until the paraffine is soft enough to permit removal of the rod. Tubing made in this way is a non-conductor, heat-resisting, slightly flexible and can be cut into desired lengths with a hack saw.

Renice Radcliffe in Electrical World

Preventing Wear of Belt Lacing

In order to prevent the undue wear of the lacing of crossed belts which ride upon one another at the point of crossing, I tack a 2-in. strip of leather to the belt directly ahead of the lacing, as shown in the accom-



METHOD OF ATTACHING PROTECTING STRIP AHEAD OF LACING

panying sketch. This acts as a separator and prevents the lacing from coming in contact with the opposite side of the belt.

M. F. Whorrell.

Cause of Noise in Water-Tube Boiler

In the plant where I am employed, one of the horizontal water-tube boilers developed a peculiar grating and scraping noise which seemed to be in the front end of the drum near where the feed water enters, and could be heard quite distinctly with each stroke of the boiler feed pump. It was decided advisable to cut this boiler out to locate the cause of the rasping noise. On entering the boiler, it was learned that the bolts holding the baffle plate over the front circulating tubes had worked out and the baffle plate was rubbing against the head of the boiler drum, which, if allowed to continue, might in time have worn a hole through the shell, or at least weakened it.

D. F. R.

Questions Answered and For Answer

Expert Help When In Trouble. If You Want Quick Answer Enclose a Stamp

Saving Condensate

WE HAVE a 40-hp. locomotive type of boiler used to furnish steam to heat the main and auxiliary engine rooms of our gas compressing station. About 15,000 cu. ft. of natural gas are consumed each 24 hr. as fuel and water is fed the boiler by means of an injector which takes its supply from a nearby creek. We are using approximately 1600 ft. of 2-in. pipe for the heaters, all of which drain to the sewer.

This arrangement appears somewhat wasteful to me and I wish to inquire how best I might return the condensation from the heaters to the boiler. What would be the most economical type of heater pump we might install under the circumstances and about what per cent saving in fuel could we expect by returning this condensation to the boiler? C. A. M.

A. The level of the heating coils is not known in relation to the water in the boiler, but it is assumed that it is below the boiler so that condensation is required to be lifted to the level of the water line in the boiler.

This may be done by using, as suggested, a pump and receiver or a system of return traps such as the Bundy or Crane tilt and others. Steam pumps are generally used for this purpose, but the exhaust steam should be returned to the heating coil to save the steam for heating and in this case, the pressure in the coil might be too high to do so, so that an ordinary belt driven pump should be used, driven by an electric motor. We do not know of any pump and receiver sets belt driven unless a motor is used because it would require some kind of a regulator for shifting the belt on and off from a loose pulley; but there are electric driven pumps and receiver sets, one of which is sold by the Buffalo Steam Pump Co., of Buffalo, N. Y.

Another way to return the condensation to the boiler would be to use 1 or 2 return traps of the Bundy or Crane tilt style. If the pressure at end of heating pipes is high enough to send the condensation to the top of the boiler, one trap will do and may be installed in the following way: Connect all of the return pipes, if more than one, into the top of a small receiver, which may be made of 4-in. pipe, and take the water out of the bottom of the receiver and run pipe to top of boiler or to return trap wherever it is set, which must be above the water line of the boiler. The water will go to the trap and from there into the boiler.

If the pressure at the end of the heating coil or coils is not enough to lift the water to top of the boiler, about 1 lb. per every 2 ft. in height, 2 traps will be needed—one to set on floor to take condensation from pipes and to send it up to the second trap which is above the water line of the boiler, and that trap to send it into the boiler. Full directions may be secured about these traps and methods of using them by writing to the makers.

As to the saving of heat in per cent, we may calculate this in the following way: At 40 lb. pressure, the total heat above 32 deg. F. is 1175 B.t.u. per pound and if water in the creek is at the temperature of 40 deg. F. the heat given to the steam by the boiler would be 1175 plus 32, minus 40, or 1167 B.t.u. per pound, and if the condensation from the heating coils were returned to the boiler, the temperature of the returns would not be less than 212 deg. F. and probably more than that, being proportional to the pressure at the trap.

Now, as a minimum, we will call it 212 deg. F. and following the same method, 1175 plus 32, minus 212, or 995, so that the saving would be 1167 minus 995 or 172 B.t.u. per pound. Dividing 172 by 1167 and multiplying the quotient by 100, we obtain 14.7 as the per cent saving possible. S. E. BALCOM.

Elevator Questions and Answers

DESCRIBE some of the various elevator safety devices in use.

2. What is a slack cable stop?
3. What is an automatic stop?
4. What is the most common defect in passenger and freight elevators?
5. Describe the proper method of inspecting an elevator.
6. What accidents are liable to happen with plunger type elevators?
7. Describe a sidewalk hoist.
8. How should a sidewalk hoist be guarded?
9. How should hoistways be guarded in a factory?
10. Describe automatic gates.
11. Describe semi-automatic gates.
12. Describe interlocking gates.
13. Describe a passenger elevator.
14. Describe air cushions.
15. How would you determine the proper load allowed to be carried on an elevator? SUBSCRIBER.

ANSWERS

EACH CAR should be equipped with a mechanical device designed to grip the rails and stop the car in case it extends a predetermined maximum descending speed, either from breaking of the cables or from any other cause. This safety device should be mounted upon the car frame beneath the platform, and should be operated by means of a speed governor located overhead. For speeds above 150 ft. per minute, this gripping of

the rails should be done gradually. A switch for emergency use should be placed in the car of electric elevators, and the opening of this switch should stop the car immediately and independently of the regular operating device. All electric elevator machines should be equipped with an electric brake, which should be automatically applied when the car stops or when the current-supply is interrupted. The brake should be released electrically and applied by means of spring pressure. Automatic limits should be placed at the top and bottom of the hoistway, to slow down and stop the car automatically at the limits of travel, independently of the operator.

Some detailed descriptions of safety stops are furnished in an article entitled "Modern Electric Elevators and Elevator Problems," which appeared in the April 15 and May 15, 1916, issues of Practical Engineer.

2. The striker, which is part of the automatic stop, is a wrought iron arm attached to the car having an eye encircling the operating cable and moving with the car during its entire travel in either direction. At each end of the run, a knob of cast iron, called a stop button, is affixed to the operating cable, which should always be so arranged as to make a down pull on the rope correspond to an upward movement of the car, and vice versa. The button is made in halves, with a properly formed groove to fit over the cable, and is clamped tightly on the cable by means of bolts. The striker arm in traveling with the car will pull the operating cable back to its former position and thereby stop the elevator on meeting with an obstruction in the form of the stop button. It is, in fact, an auxiliary limit stop and, if it is set properly, should stop the elevator of itself a little in advance of the automatic limit stop. It thus saves that valuable and useful device from wear and tear, leaving it in fine condition to perform its duties without fail, in case the operating cable breaks or the buttons slip. The student will readily see from this description that this combination really forms a double safety. The slack-cable stop is an attachment designed to stop the elevator instantly in case the cables become disarranged on the drum, and is an appliance which should be on every elevator driven by power.

3. Automatic stops placed on the elevator car consist primarily of catches in the form of wedges, pawls, etc., that lock the car in case of emergency. In some designs only the breaking of a cable will operate the stop, while in other designs, excessive speed of the car will operate them.

4. We do not know what the most common defect of a passenger or freight elevator is. Any classification of elevators is usually made according to type—hydraulic, electric or steam—rather than the nature of its service. Following are the limitations of the various types: The hydraulic plunger type is limited to speeds of 400 to 600 ft. per minute, due to the difficulty in making accurate stops at higher speed. The low-pressure cylinder type is limited by the space required for cylinders. The electric drum type is limited to medium lifts, owing to the width and diameter of drums on which the cable must be coiled.

5. Elevators, of the vertical hydraulic type, in one Chicago office building are given a daily inspection as follows: An examination is made of the nuts and bolts on the operating mechanisms of the elevator, to see that none are loose or broken; and the sheaves are examined for cracked spokes. After this is done, the car is run up to the top, then down to the bottom, to see that the limit or automatic stops are working. While this is being done the lifting and hand cables are examined for broken strands or weak sections. After everything has been oiled and examined and apparently in safe operating condition, the safety dogs, or automatics, are set to prove that they are in good working order, and also that the governor is properly set to release the dogs so that they will operate and stop the car at a predetermined speed.

6. We do not know of any specific accidents to which plunger elevators are liable.

7. A sidewalk hoist is of the direct plunger type. In place of the usual striker or stop arm on the platform of the car a chain passing through a hole in the platform and having a ring at either end is used. The operating cable, upon which stop buttons are set, runs through the ring at one end of the chain. The stop buttons are so arranged that, as the car approaches either limit of its travel, the ring engages with one of them and pulls the cable in the direction to operate the control valve and stop the hoist. When the car is at the upper landing, it may be lowered by pulling upward on the ring.

Where the opening at the upper landing is covered by trap doors, a heavy channel arch is commonly provided on the car to push the door open as the car ascends.

8. A sidewalk hoist opening should be guarded by collapsible gates placed between the open trap doors.

9. Hoistways in a factory should be protected by a closely woven grating at least 5½ ft. high on all 4 sides.

10. One form of automatic gate employs a horizontal pneumatic ram at each landing to open and close the gate or door automatically. The piston of the ram is attached by a link to a long swinging lever connected to the gate, and as the ram piston moves one way or the other, it carries the gate with it. The device is so designed that the gate is always held closed until the car is at a landing, when the operator, by pressing on a treadle, throws a movable vertical shoe against a suitable part of the valve gear. This operation unlocks the gate and admits air under pressure to one side of the piston in the ram cylinder, at the same time opening the other side to exhaust. The gate now opens, and when wide open can be kept open by a finger lock as long as the car is at rest. Whenever the operator removes his foot from the treadle or unlocks the finger lock, or starts the car in either direction, the gate closes automatically by reason of the return of the valve gear to its original position. This device is employed extensively in passenger service.

11. A counterweighted gate, which is lifted vertically by hand, and engages a supporting device when the car is at the landing, and which closes by gravity as the car moves away, is known as a semi-automatic gate.

12. As we understand it, an interlocking gate consists of 2 gates, one on the car and the other on the

shaft. It is necessary for the car to be at the floor level before either gate can be opened, as the opening operation depends upon an interlocking action.

13. The subject of passenger elevators is so comprehensive that this question cannot be answered as it stands.

14. If, when the cable breaks, the car safety should fail to operate, the car will drop unretarded to the bottom of the hoistway, and the air cushion assists in preventing serious destruction of property and injuries to passengers. This air cushion may be formed by extending the hoistway below the lowest landing in the form of a pit, which has a cross-section at its top somewhat larger than the platform of the car and which gradually tapers toward the bottom to nearly the cross-section of the car. When the car falls into this pit, the air within it is compressed and is forced out gradually around the platform of the car, thus slowly retarding the drop.

Air-cushion pits, to be effective, should have a depth equal to 1/5 the entire length of the car, and the walls should be air-tight.

15. The live load for passenger elevators is commonly 75 to 80 lb. per square foot of platform, and the weight of the car itself from 100 to 125 lb. per square foot of platform. Commonly 140 lb. is allowed for each passenger.

W. P.

Peculiar Generator Trouble

WE HAVE a Fairbanks-Morse direct-current generator rated at 220 v. and 14.7 amp. and operating at a speed of 1900 r.p.m., but which does not deliver more than 10 amp. at a voltage of 150. In fact, after the machine has been running for some little time the voltage drops as far as 75 v.

The generator was formerly able to deliver its rated output, but it will not do so any more. It is belt driven from a line shaft, the speed of which is not constant.

Can you tell me what the trouble may be? J. S.

A. If there has been no change in the connections, it is quite evident that there must be some fault somewhere, for a machine rated for 220 volts would certainly never go down to 75 or 100, unless it is far below speed, or the field excitation is seriously weakened. If enough armature coils were burned out or short-circuited to reduce the voltage this much, it would be indicated by a violent sparking on the commutator.

The drop in voltage after your machine starts up may be caused either by slippage of the belt when the load is thrown on, or by increase of the resistance in the field circuit due to heating up of the coils. We rather suspect the latter to be the case, and that the great lack of voltage in your machine is due to a short-circuiting in the field circuit, which cuts out a considerable part of the excitation. If this were true, you would then be working on a part of the magnetization curve, where a slight change in magnetization or in speed would considerably affect your voltage, which is apparently what happens.

Go over the field connections to make sure that there is no shorting from one terminal to another of any of the field spools, and if you find this is all right, test up the voltage drop from terminal to terminal on each field spool. See if this is the same for all.

This drop test is preferably made with a portable voltmeter, although it can be done by taking leads from the switchboard voltmeter—disconnecting that instrument, of course, from the terminals of the dynamo or bus bars—and measuring the voltage drop across each coil when the machine is in regular action. This test should be made both soon after starting up, when the voltage is high, and later when the voltage has made the large drop that you state occurs, so as to see what change, if any, is made in the field resistance by the heating up of the coils.

A. L. R.

Characteristics of Bearing Metals

WHAT METAL is usually added to babbit to make it harder?

Is zinc used much in babbit, or is it too hard? If used, would it make the babbit tough, hard or brittle? Does it shrink much upon solidifying after pouring?

F. H.

A. The composition of the alloy generally known as hard, genuine babbit, is made up of approximately 83 per cent tin, 8.5 per cent antimony and 8.5 per cent copper; or 80 per cent tin, 10 per cent antimony and 10 per cent copper.

The method of casting and rate of cooling have a very important influence upon the structure and service which these metals will give. The rate of cooling affects the hardness of the matrix, and the size and number of the tin-antimony crystals. The proper temperature for pouring is approximately 432 deg. C. (810 deg. F.), and the metal should preferably be cast against a chill heated to a temperature of approximately 100 deg. C. (212 deg. F.), so that the rate of cooling is not too rapid.

Relative to tin base babbits containing zinc, The Mechanical Engineer's Handbook gives the following:

"The most important alloy of this class is Parsons white brass, which consists approximately of 62 per cent tin, 35 per cent zinc and 3 per cent copper. It is largely used for marine bearings, and to some extent for automobile bearings. It is hard, tough, rather sluggish to pour, and cannot for this reason be cast into thin sections after the manner of using the ordinary babbit metals. It must be poured at a fairly high temperature approaching redness, and is preferably peened after casting to compress the metal and so add to its durability under the influence of wear."

O. H. H.

Actual Travel of Slide Valve

WHAT IS the actual travel of a slide valve? J. K.

A. The travel of the common slide valve is the distance that it moves from one extreme position to the other. It is twice the port opening plus the lap on both ends. If you understand the port opening as the distance that the valve moves after the port begins to open, this is not necessarily the same as the width of the port, since the valve may be designed so that it does not open the port full width at any time, or it may travel beyond the farther edge of the port.

The valve travel is, of course, equal to twice the radius of eccentricity, or is equal to the throw of the eccentric in a direct connected valve.

A. L. R.

Problems For Discussion By Readers

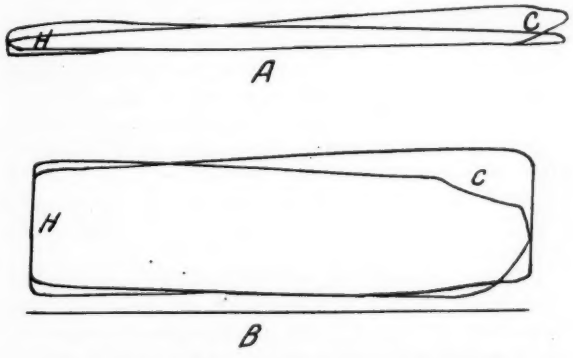
What Would You Do If You Had These Conditions To Meet?

Puzzling Problem in Combustion

WHAT EXPLANATION can readers of Practical Engineer give for the following conditions? In using coal for fuel with a furnace temperature of 1400 deg. F., draft 0.25 in., gas analysis showing 11.5 per cent CO_2, 2.5 CO, 0.1 O, the flue gas temperature in the uptake is 500 deg. F. We have gone over to tar oil as fuel, and with the same load as was carried with coal, we get a flue gas temperature of 740 deg. F., with a gas analysis of 13 per cent CO_2 and 1.5 per cent CO. I have varied the draft from 0.03 to 0.35 in., but the gas temperature still remains high. The baffles are all in good order. R. A. F.

What Is Your Opinion?

G. W. M., WHO HAS SUBMITTED the two cards shown herewith, desires the readers of Practical Engineer to offer any criticisms they may have to make and suggestions whereby he may correct the valve setting of his engine so as to obtain better cards.



(A) CARD TAKEN WITH NO LOAD ON ENGINE
(B) CARD TAKEN WITH ENGINE LOADED

The engine is of the slide valve type, having an 11-in. piston, a 16-in. stroke, and was operating at a speed of 96 r.p.m. when the load card was taken and at a speed of 110 r.p.m. when the no-load card was taken.

Is the Indicator at Fault?

I THINK E. C. D. is too hasty in his judgment of the indicator in question. Such deformations as the diagrams show, may be produced by even the best makes of instruments; no intrument should be condemned because of them. The fault may be in the design of the engine cylinder, or possibly in the valve setting.

It seems to me that if E. C. D. will try again with an 80-lb. instead of the 70-lb. spring, some of the irregularity will disappear. The slight disturbance, due to the inertia of parts of the instrument, is always present in any indicator, no matter how well made, and a comparatively light spring magnifies the trouble. I know that a 70-lb. spring is good for 125 lb. pressure; but under the conditions, I think an 80-lb. spring would be better. Why not try it?

The diagram from the throttling engine seems to show that the compression pressure rises above the initial pressure, and that, together with the inertia effect, causes the projections at the upper parts of both diagrams. The indicator is doing just exactly what should be expected of it in this case. The faults are not wholly with the instrument, and that which may be, is unavoidable.

The Corliss engine diagrams show clearly that the steam events are all late. The eccentric should be given more angular advance, and a better condition of affairs will be obtained all around. The cutoffs will be taken care of by the governor during ordinary loads; not by the eccentric. The eccentric will control the cutoff only when the load is such that the governor cams will not operate. I think it will be quite safe for him to change the position of that eccentric.

It also appears to me, that the steam ports were not as large as they should be to give a quick entrance of steam into the cylinder, to follow the moving piston. The indicator shows these things, and in so doing, I would assume that it is a good instrument. A good instrument will show a bad condition of affairs, if a bad condition exists. A perfect diagram does not necessarily mean that a first class indicator has been used, and vice versa. C. J. M.

Troubles With Frozen Air Lines

I HAVE READ many remedies for frozen air lines; but when we experience trouble continually with the same thing and are compelled to apply the remedy continuously, such as keeping hot ashes on the air line that keeps us watching the fire lest it destroy the plant and neglecting other things that demand engineers' attention. Why not when we are compelled to remedy trouble do it permanently? Frozen air lines first form a coating of frost around the walls of the pipe and when the thaw comes it forms ice which clogs up the ells. Now, where we have any back pressure, as most plants have, why not run ½-in. pipe line from the exhaust under the air line and the trouble will disappear for good?

W. H. BLAKE.

U. S. CIVIL SERVICE COMMISSION announces an examination, July 17, for metallographist; salary, $2200.

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Emergency Power for War Service

Gratifying recognition of the importance of the power plant in time of war no less than in peace is to be found in a message recently addressed by Governor McCall to the Massachusetts Legislature on behalf of the Fore River Shipbuilding Co. of Quincy. This great industrial plant, which is working hard to fill war orders for the United States Government, informed the governor not long since that the generating capacity of its own power station at the shipyard has reached its limit, and pointed out that if permission could be secured to purchase surplus power from the adjacent large generating station of the Bay State Street Railway, the situation would be greatly helped. The governor promptly referred the matter to the Legislature, which must grant the necessary authority to the railway company to sell its off-peak power to an industrial concern, and there is little doubt at this writing that the deal will go through successfully.

In ordinary times, the supply of off-peak power from a railway plant to a shipyard might be of only passing interest; but there is an economic principle involved here which may well be applied in other cases. As the nation speeds up its great task of preparing to do its share in overwhelming the common enemy of the allied powers of liberty, every possible resource should be utilized along the line of turning existing power generating facilities to the fullest account. It will be most helpful if those in control of power plants within interchange radius will get together and see where different installations can assist each other. In many cases the cost of temporary inter-station lines will be negligible in comparison with the cost of waiting for additional generating equipment, even if the latter has been ordered from the manufacturers. At Quincy Point, for example, the railway plant is an alternating current station with a local rotary converter substation, the installation being within a few hundred feet of the Fore River works. This should make it easy to supply, at least temporarily, either direct or alternating current, or both, and at relatively low cost, since the railway company is reported to have offered to supply energy at a very modest charge during off-peak hours.

There is certainly an opportunity for a good many power plant owners and engineers to investigate the possibilities of helping to supply emergency power during the war through what might be called the matching of load curves, and it should not be forgotten that such sales of off-peak power will in almost every case result in a lower fuel consumption per kilowatt-hour and thus assist in conserving the coal supply within certain limits. These considerations would be important in times of peace; but they are of still more significance at a time like this, when military and naval preparedness must be pushed without regard to cost.

Editorial Comments

THE MODERN POWER PLANT FOR THE KIMBALL BUILDING is a definite proof that we are now well entered upon an era of inventions which will eliminate to a great extent the errors due that uncertain factor commonly called the "human element." More specifically, we refer to devices designed to start and stop machinery, maintain proper conditions of speed, temperature, pres-

sure, levels, draft, or what not, which operations have in times past put a tax upon the vigilance of those in charge. Automatic operation does not relieve the attendant of responsibility for perfect operation, but it puts into his hands a device which works according to known physical laws and will maintain desired conditions closer, in most cases, than can be done by human hands. In the power plant is a rich field for such devices and in that of the Kimball Building are more than are usually provided for plants of this type.

OIL-BURNING SYSTEMS are being given more consideration in the past few months of high priced coal than formerly and the article by Mr. Teiper should be read with the idea that the information given may be used in your own plant. At any rate, if you are burning coal just make a definite comparison of your present fuel costs with estimated costs of fuel oil and you may be surprised at the possible saving due to a change in fuels.

TESTS OF UNIFLOW TRACTION ENGINES, conducted by Professor Marquis, prove without a doubt that this type of engine has a field largely to itself on steam tractors where condensers are impracticable. The construction of the engines tested is also interesting and a study of the diagrams will be profitable as the design shows several points of improvement over earlier types of uniflow engines.

USE OF THERMOMETERS TO INCREASE BOILER EFFICIENCY should by all means be resorted to in every plant. Thermometers for such uses as explained by Mr. Cozzens are not prohibitive because of initial cost and when the test results are properly interpreted there is no better aid for securing highest economy.

EVAPORATION is often referred to as the only real test of value in determining upon what coal to contract for. In the article under this heading in this issue some of the dangers of misinterpreting the results are pointed out and a careful reading should prevent you from relying upon a half-truth.

THE FEDERAL CAPITOL ILLUMINATED presents lines of beauty probably never before recognized by the tourist as the flood lighting is directed to best advantage which could never be done by natural light. The engineering features of this work are given on another page and will be recognized as simple compared to the magnificent results obtained.

LABOR DATA ON UNDERGROUND CABLE CONSTRUCTION, to our knowledge, has never before been published in such complete form as is given by Mr. Morgan. From this an estimate of work to be performed can readily be calculated and many contractors keep such information, gained from their experience, under lock and key.

WASTING AIR UNNECESSARILY is no uncommon occurrence in power plants and machine shops. Mr. Jahnke tells us of some places where leaks occur and gives the remedies to apply. There will be no excuse for allowing air to be wasted after reading his article.

LETTERS DIRECT FROM THE PLANT contain two of more than usual interest. The water-tube boiler is shown in one instance to be safe; however, this is no excuse for careless operation. Making the Corliss engine do more work is a problem which has led to considerable discussion and in this issue Mr. Cultra brings out some facts which will aid in the solution.

SAVING CONDENSATE is a problem to be solved in every plant. This question is answered by Mr. Balcom and what he says should be made common knowledge to power plant men. Characteristics of bearing metals is another question which comes up quite frequently and the information given in the answer should be retained for use in an emergency.

A Test of Your Plant

Draw a sketch of your boiler and setting, locating baffles, arches, bridgewall, feed piping, blowoffs, etc. Criticize the design as to proportions of furnace, gas spaces, location of soot blower and types of mountings.

Devise a scheme for changing the speed of your stoker automatically with variations in the load on the boiler.

Check up the design of your steam piping system to see if pipes are of proper size for present conditions, emergencies have been provided for, valves are of proper type and in right places and the drip system is adequate. You will find help in the leading article.

Can you install and operate an oil-burning system in your plant? Will it pay? What equipment is necessary and what method of atomizing will you recommend? How will you check up oil shipments?

Why don't you recommend a uniflow engine the next time your plant is in the market? It has advantages in some places; is your plant one of them?

Have you conducted a thorough test of your boiler room? What temperatures did you measure? What range thermometers did you use and where did you locate them?

Did you make a simple evaporation test to determine what coal to buy? Did it prove profitable? If not, why not?

What will it cost your plant to dig a trench for an electric conduit between buildings?

Where do you look most carefully for leaks in the compressed air piping system about your plant and works?

Does your boiler installation conform to the state law?

Aids to answer all of these vital questions and more are given in the articles of this issue; have you read them thoroughly?

FROM A REPORT of the United States Geological Survey for May, 1917, the bituminous coal shipments on 82 railroads amounted to 739,674 carloads, which is 12.4 per cent greater than in April, 1917, and 23.8 per cent greater than in May, 1916. Average cars loaded per day for May, 1917, were 8.1 per cent above the number for April, 1917, and 23.8 above that for May, 1916.

Power Apparatus in Shop and Market

New Ideas In Making, Buying and Selling

Robertson Dry-System Oil Purifier

AMONG the devices for increasing economy in the power plant, the oil purifier takes a prominent place, for with it all used oil that can be caught can be reclaimed and used over and over again, only a small percentage being lost by use. The oil purifier is applicable to the smallest as well as the largest plant, and illustrated herewith is a type suitable for use in plants where no central drip system has been provided. This filter, made by John F. Robertson Co., operates on the dry principle; i. e., the oil does not pass through water during the process of purification.

The operation of this purifier is as follows:

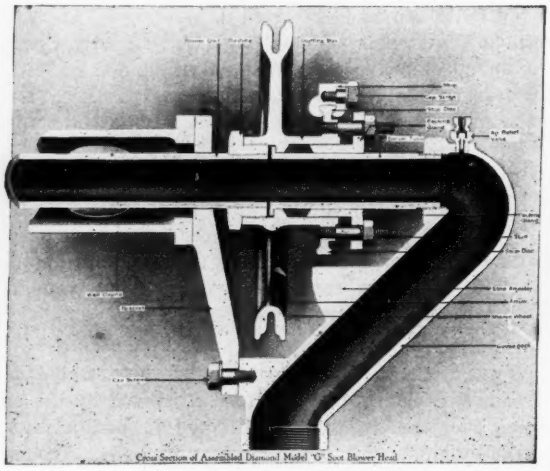
Used oil is first poured into the strainer, which receives the coarser particles of dirt as well as small pieces

ROUND TYPE ROBERTSON DRY-SYSTEM OIL PURIFIER

of waste, etc., that may accumulate. In this compartment, oil is held and is being heat treated by the steam jacket until there is a sufficient quantity of oil to cause it to flow through the nipple separating this compartment from the next; here it is again held for heat treatment until a sufficient amount of oil is again passed through the strainer, forcing the oil into the second compartment, causing it to overflow downward through the first baffle, the flow downward more readily deposits the sediment in the bottom of the next compartment. The oil is held in the third compartment, is given another heat treatment until sufficient oil passes around the system to cause the oil in this compartment to overflow into the fourth; here, again, it is heat treated and when the oil reaches the same level in all compartments, it flows through the nipple into the filter bag, where the finer particles of sediment, graphite and floating mica are strained; the oil then passes into the clean oil chamber.

New Mechanical Soot Blower Head

GREAT dependence is placed on the head of the mechanical soot blower system and it is necessary that it be designed and built for long, uninterrupted service. Every part must be machine finished to exact dimensions. In the new Diamond soot blower head the steam inlet, or goose-neck, is a special design and permits the riser steam pipes to be brought close to the boiler wall. It also permits ease of access to the packing gland whenever repacking is required. It is made of



IMPROVED DIAMOND SOOT BLOWER HEAD

heavy gray cast iron and tested to withstand modern high steam pressures. It is machined to receive the riser steam pipe at one end and the tube upon which the packing box of the blower revolves at the other. One boss is cast and machined to fit the bracket which supports the inlet from the wall casing. Another boss is cast between the two ends and serves to arrest the motion of the blower unit in conjunction with the automatic stops. These stops are so placed as to prohibit the steam from the blower nozzles from blowing against the baffles.

The operating wheel is a hand wheel or chain sheave, depending upon the distance of the unit from the floor.

Chain grooves on the sheave wheel prevents slippage of the chain when the unit is being operated.

The packing gland is cast of a special metal, machined to a mechanical fit within the packing box, which is cast integral with the operating wheel. It is so built that the packing is easily forced into steam-tight contact with the stationary parts of the unit by hand adjustment.

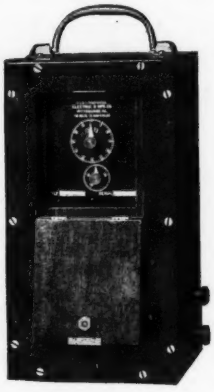
A special wall casing is provided for each unit. It is made in rectangular box form, with flange at rear and bosses at distal end to anchor it securely when bricked permanently in the setting. The entire construction is such that the blower element may be revolved freely without admitting air to the interior.

Each head is provided with a Diamond vacuum breaker or air-relief valve which operates at atmospheric pressure. This valve operates automatically, opening immediately the steam is turned off from the unit, thus preventing the suction of furnace gases into the piping.

Westinghouse Cycle Counter or Timing Device

AS is generally known, it is not possible to obtain satisfactory results in the testing of time elements of high accuracy relays and of circuit breakers with a stop watch, particularly where the selective action of the circuit breaker is essential. For this purpose, the Westinghouse Electric & Mfg. Co. has developed the cycle counter shown herewith, which is a device for indicating definitely the number of cycles required for the relay to close its contacts.

The mechanism of this timing device consists essentially of an electric self-winding clock, the escapement of which is operated by an alternating-current oscillating magnet instead of a pendulum or balance wheel. At each cycle, one tooth of the escapement is released. The



WESTINGHOUSE CYCLE COUNTER OR TIMING DEVICE

self-winding clock periodically rewinds by means of power supplied from a shunt connection to the circuit when the cycle pointer has made 60 revolutions, the equivalent of 3600 cycles. This arrangement keeps an even tension on the escapement. Thus, the escapement magnet is not depended on to drive the indicator, but simply to regulate its speed. The power for driving is furnished by the clock mechanism.

In operation the cycle counter is connected in series with the relay on a circuit adjusted to give the current value at which it is required to test the relay. When the circuit is closed, the "cycle" pointer begins to revolve, one step per cycle, and continue to do so until the contacts are closed. The instrument acts as if it had no inertia; that is, it starts the instant power is applied and stops the instant power closes.

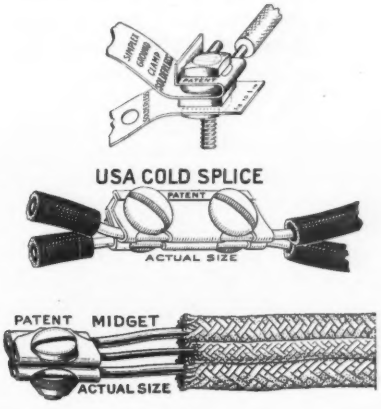
Although primarily designed for use in testing or adjusting time-element relays, this instrument is suitable for a great variety of testing. Its particular field of usefulness is for measuring elapsed time intervals too short to be satisfactorily observed with a stop watch and where readings in steps of one alternation are sufficiently accurate, obviating the use of complicated and expensive apparatus such as chronographs or oscillographs.

Given a known frequency, the readings can be reduced to seconds if desired. Conversely, by connecting the instrument to a circuit for a definite period of time the frequency can be determined. By adding contacts to machine tools, elevator machinery, etc., the time required for various functions can be determined.

Solderless Wire Clamp Connectors

CONSIDERABLE time and work ordinarily expended in the making of soldered electrical connections may be eliminated by the use of the new line of solderless type of clamp connectors made by Alexander P. Simpson of 152 East 53rd St., New York, and shown herewith.

By employment of the U. S. A. Cold Splice, a substantial, reliable, safe, simple and clean connection may be made of four or less wires of different sizes without



THE SIMPSON WIRE-CLAMP CONNECTORS

torch, flux or solder and their attendant damage and mess. Connections and disconnections may be quickly made and the limited working space in outlet, switch and junction boxes may be greatly economized.

After loosening the screws slightly, each wire is threaded into one of the four loops and secured by tightening the screws, the final turn causing the knurl of the nut to grip the wire and to hold the nut.

In the U. S. A. Simplex Ground Clamp, the ground wire is threaded through the loop, bent around the screw

and secured by the tightening up of the nut. The screw does not turn.

Three or less wires of various sizes may be accommodated by the U. S. A. Midget Clamp, a connector especially designed for fixture work. A double connection of five wires may be made by threading two of these clamps on one wire and securing the other four wires in the regular manner.

News Notes

THE BIGELOW CO., New Haven, Conn., announces the death, on June 20, of the company's president, Frank Lewis Bigelow.

A. G. FERNEKES, formerly with Pawling & Harnischfeger, of Milwaukee, Wis., has been appointed advertising manager of the Buffalo Steam Pump Co., and Buffalo Forge Co., of Buffalo, N. Y.

GEORGE M. DRILL, following his successful engineering practice in Chicago, specializing in the design of power and manufacturing plants, industrial problems and examinations, has located for the present at 7 Cromwell Place, White Plains, N. Y., and will act in a consulting capacity for manufacturing concerns and financial interests.

GEORGE A. TEELING, formerly with the Green Fuel Economizer Co. and with Carlisle & Gale, and who for 2 yr. was in the Panama zone doing engineering work under Governor Goethals, has become associated with the Coppus Engineering & Equipment Co., in the Engineering and Sales Dept. For the past 2 yr. Mr. Teeling has been in the Engineering and Sales Department of the B. F. Sturtevant Co., of Hyde Park, and in all his work has had a long experience with air delivery and the use of fans. This experience will be of great value in solving difficult problems for those who contemplate using Coppus equipment.

AT THE REGULAR MEETING of the Board of Directors of the Westinghouse Electric & Mfg. Co., held in New York on Wednesday, June 20, an extra dividend of ½ of 1 per cent on both common and preferred stock was declared for the benefit of the Red Cross fund. This dividend, which will amount to approximately 375,000, is an addition to the regular quarterly dividend of 1¾ per cent on both common and preferred stock, which was also declared.

At this meeting, the annual election of officers of the company was held: Chairman of the Board, Guy E. Tripp, President E. M. Herr, Vice-Presidents L. A. Osborne, Chas. A. Terry and H. P. Davis, Acting Vice-President T. P. Gaylord, Comptroller and Secretary James C. Bennett, Assistant Secretary W. H. Jones, Assistant Treasurer and Assistant Secretary S. H. Anderson, Auditor F. E. Craig, and Assistant Auditor W. B. Covil, were re-elected to their respective offices. Three new vice-presidential offices were created and the following were elected to fill them: Henry D. Shute and Herbert T. Herr, both of Pittsburgh, and Walter Cary, of New York. H. F. Baetz, assistant treasurer, was elected to succeed Mr. Shute in the position of treasurer. L. W. Lyons was elected assistant treasurer to succeed Mr. Baetz and W. J. Patterson was elected to the newly created position of assistant auditor.

CHAS A. SCHIEREN CO., New York, manufacturers of Duxbak Waterproof and Steamproof Leather Belting, have recently opened branch offices at 72 Congress St. West, Detroit; 18 So. Broadway, St. Louis; 475 So. Main St., Memphis; 272 Marietta St., Atlanta, in addition to those already established at New Orleans, Dallas, Boston, Philadelphia, Pittsburgh, Chicago, Denver and Seattle. These, with jobber representation in all the principal industrial centers, give further assurance of prompt service to users of Duxbak Belting.

IT IS REALIZED that to secure the best results in the intensive activity which will be necessary for producing the materials required for carrying on the war, industrial harmony and the best possible condition of workers is essential. Most leaders of industry realize the importance of assisting in caring for the health and well-being of employes, but have found it difficult to care for this work through their own organizations, partly because of the pressure of other necessary activity, partly from lack of understanding of the needs of the work.

In this field, the Industrial Department of the Young Men's Christian Association of the country has been active, and their services and assistance have been utilized by many communities to the great benefit of all industries therein. The great need is to keep men fit physically, mentally and spiritually, and the Association can, and does, do much, by the activities of its various departments, in rendering this special service. Full information as to the method of cooperation may be had from the International Committee of Young Men's Christian Association, 124 E. 28th St., New York City, or from the Association headquarters which are to be found in practically all of the larger cities throughout the country.

Book Reviews

EXAMPLES IN BATTERY ENGINEERING, by Prof. F. E. Austin; 90 pages, 39 illustrations, cloth; first edition, Hanover, N. H., 1917. Price, $1.25.

To those already acquainted with the works of Prof. Austin on subjects of electrical engineering, reviews of a number of which have already appeared in these columns, little need be said regarding the merits of his writings. These have dealt with various phases of both direct and alternating-current theory and practice; and, due to his belief that engineering students as well as those engaged in professional practice should have an adequate knowledge of the fundamental principles forming the foundation of "battery engineering," this volume has been prepared.

The work is divided into 16 lessons, devoted to both primary and secondary batteries; and in order to aid in a thorough understanding of the text, numerous examples and problems for solution by the student are given. Of necessity, considerable mathematics has been introduced, and while some of this involves the higher branches, the majority of formulas are of an elementary nature, thereby putting the matter in a form readily understood by the student having a working knowledge of algebra.

These tables contain data especially worked out or carefully selected that are vital to your work. You may need them at any time and should preserve them. A handy, serviceable, loose-leaf cover in which these tables fit exactly, will be sent you for 30 cents in currency or stamps.

These tables contain data especially worked out or carefully selected that are vital to your work. You may need them at any time and should preserve them. A handy, serviceable, loose-leaf cover in which these tables fit exactly, will be sent you for 30 cents in currency or stamps.

PRACTICAL ENGINEER

GUARDS FOR POWER TRANSMISSION MACHINERY

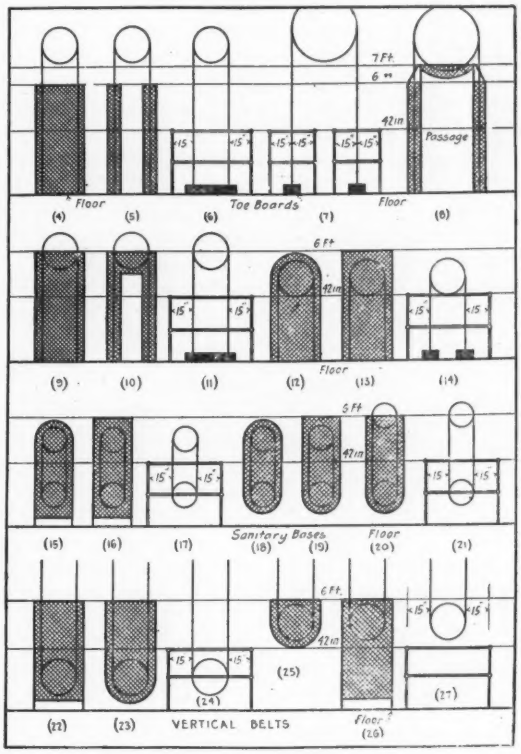
On these pages are given illustrations suggesting methods of protecting workmen from accidents due to contact with moving power transmission machinery. These suggestions are incorporated in the tentative draft of a code of safety standards presented at the spring meeting of the American Society of Mechanical Engineers. The devices illustrated are applicable to all main shafting, jack shafting, drive shafting and counter shafting, and their belts and other attachments up to but not including belts actually driving machines.

Standard guards are of metal, when within 5 in. of the part guarded the mesh must not admit objects over ½ in. in diameter, when over 5-in. objects over 2 in. diameter must not be admitted. Hand rails may be of pipe, structural metal or wood and when placed 15 in. or more from guarded part measured horizontally, the hand rail should be 42 in. in height with at least one intermediate rail and supported at least every 8 ft.

Toe boards should be provided 6 in. in height as indicated in Figs. 6, 7, 11, 14, 30, 31, 34 and 48. For sanitary reasons openings are provided at the bottom of guards as shown in Figs. 15, 26, 36-40, 42, 43, 49 to 54. Guards for vertical or inclined belts should be 6 ft. high on all exposed sides, see Figs. 4 to 46. Low belts should be guarded on exposed sides and top or provided with rails, see Figs. 47 to 50. Medium and high belts may be guarded with metal netting or rails as indicated in Figs. 51 to 60. The rule is to guard all moving parts less than 7 ft. from floor.

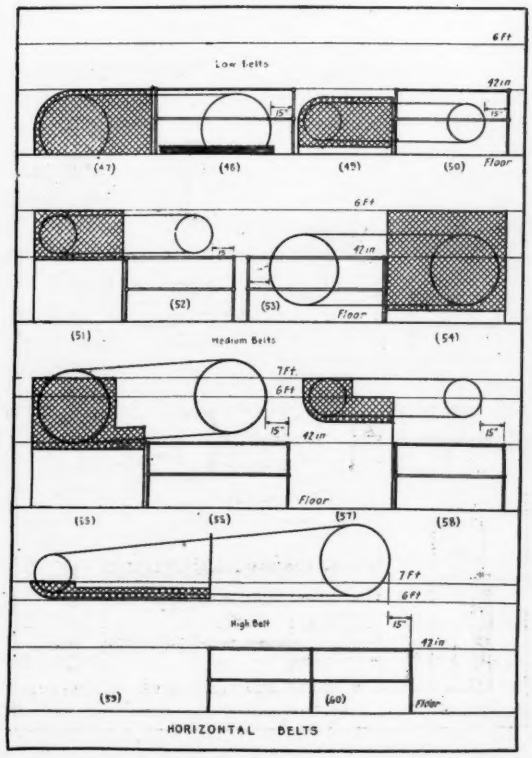
PRACTICAL ENGINEER

GUARDS FOR VERTICAL BELTS



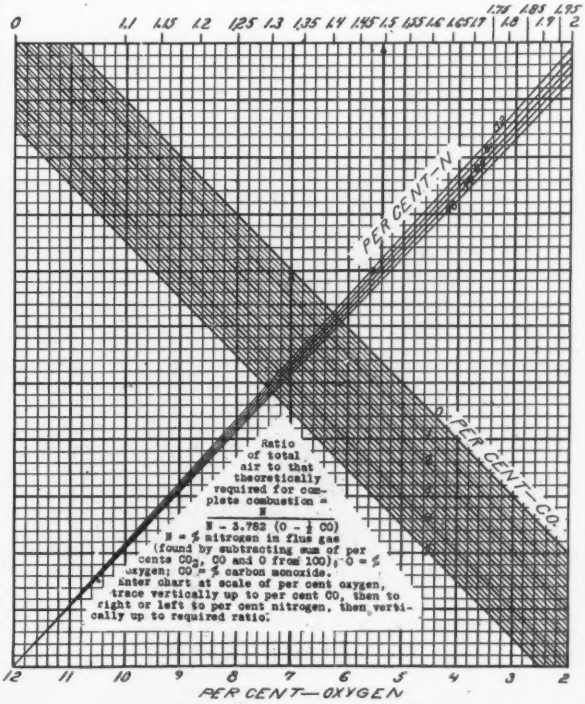
PRACTICAL ENGINEER

GUARDS FOR HORIZONTAL BELTS

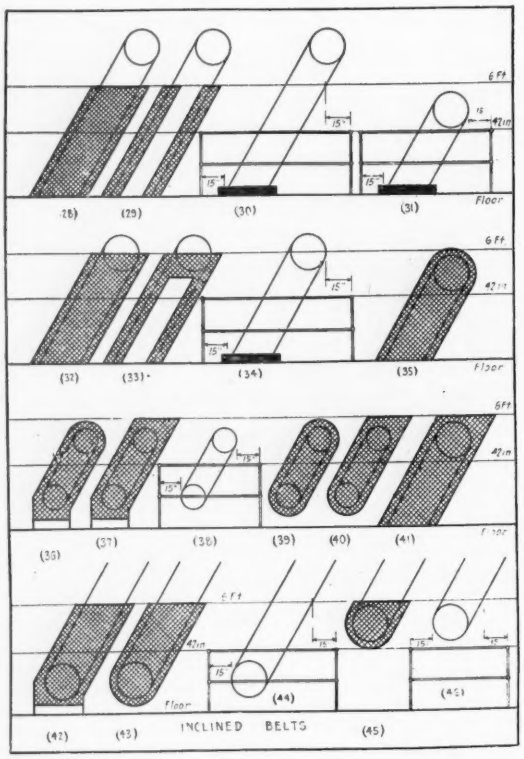


PRACTICAL ENGINEER

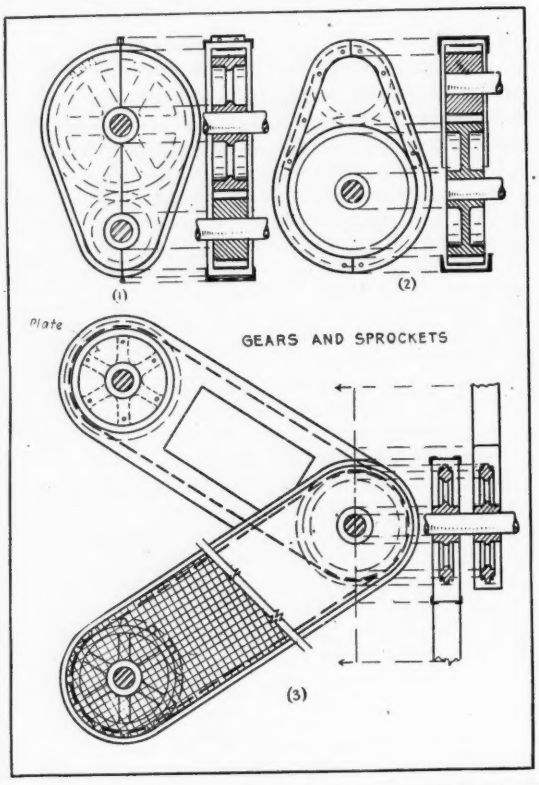
RATIO OF TOTAL AIR USED TO THAT THEORETICALLY REQUIRED FOR COMPLETE COMBUSTION, CALCULATED FROM FLUE GAS ANALYSIS



GUARDS FOR INCLINED BELTS



GUARDS FOR GEARS AND SPROCKETS



TONS BITUMINOUS COAL IN OBLONG PILE

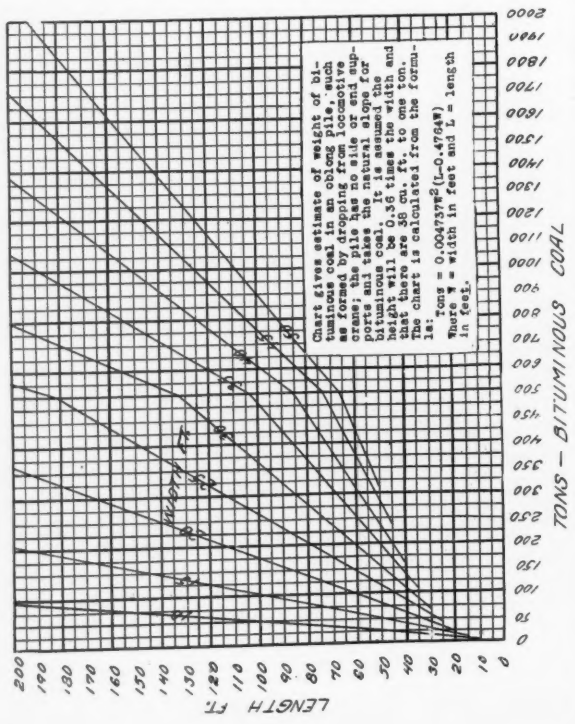
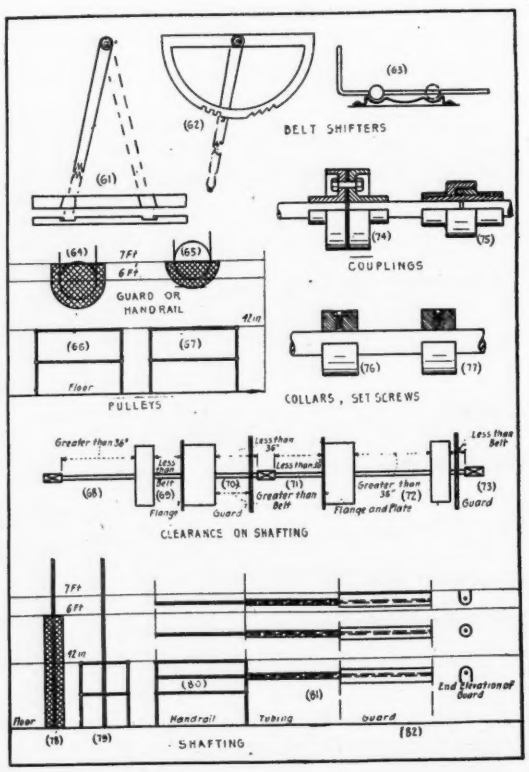


Chart gives estimate of weight of bituminous coal in oblong pile as measured by dimensions from locomotive or near the pile but no side or end supports and takes the natural slope for bituminous coal. It is assumed the height will be 0.36 times the width and that there are 36 cu. ft. to one ton. The chart is calculated from the formula: Tons = 0.004737W²(L−0.4764W) Where W = width in feet and L = length in feet.
TONS — BITUMINOUS COAL
LENGTH Ft.
WIDTH Ft.

GUARDS FOR MISCELLANEOUS EQUIPMENT



The arrangement of the subject matter in lessons under important subject headings adapts the volume for use as a text book, while the discussion of the application of theory to practice renders the book useful to electricians, and all in charge of primary and storage batteries.

MECHANICAL EQUIPMENT OF BUILDINGS, Vol. II, by L. A. Harding and A. C. Willard; 766 pages, illustrated, flexible binding; first edition, New York, 1917. Price, $5.

This is the second volume of a set of three and is devoted to power and refrigeration equipment, with particular reference to such as employed in isolated plants. Volume I, a review of which appeared in these columns some time ago, covers the subjects of heating and ventilation, while miscellaneous building equipment, such as lighting units, elevators, vacuum cleaning and sprinkler systems and plumbing, are to be discussed in the third volume now in preparation.

Some of the material found in this volume, such as that treating the subjects of heat, water, steam, air, fuels, combustion, etc., has, it is apparent, been taken from Volume I, thus making this volume a complete individual unit and thereby avoiding the necessity of constant reference to the other.

Chapters IV to IX, inclusive, bearing the titles of Boilers and Rules for Construction, Superheaters and Economizers, Chimneys for Power Boilers, Mechanical Draft, and Feed Water Heaters and Feed Water Purification respectively, embody much information on current practice which should prove of considerable value to both the designing and the operating engineer concerned with economy and efficiency in connection with steam plants.

Theoretical and practical considerations of engines, turbines, pumps and condensers are taken up in much detail in Chapters X to XIII, inclusive, while the following chapter is devoted to cooling ponds and towers, equipment rapidly coming into more general use due to the continual rise in cost of fuel. Pipes, fittings, valves, coverings and accessories and their proper use and installation are dealt with in Chapters XV and XVI. Typical installations are pictured and discussed in some detail in the chapters entitled Arrangement of Steam Power Plants and Coal and Ash Handling Machinery, as also to some extent in Chapters XXI to XXXI, inclusive, which take up in detail refrigeration, refrigeration machinery and auxiliary equipment used in connection therewith.

Much data on isolated plant work is given in Chapter XIX, while in the following chapter are found detail cost figures of steam and gas power equipments taken from actual installations, and while these figures are, to some extent, considerably lower than present-day prices indicate, they will at least serve the engineer in making an approximation.

The many clear-cut illustrations, charts, curves and tables embodied in this work add much to the value of the book.

STATE SANITATION. Volume I, by George Chandler Whipple, 367 pages, 6 by 9 in., illustrated. Cambridge, Mass., 1917.

This book is a review of the work of the Massachusetts State Board of Health, beginning with the early history of public health orders in the settlement of Boston. The primary object, as stated by the author, is to set forth the past work of this board so that it may be known by the people of the present generation. Although annual and other comprehensive reports have been issued, many of these are now out of print and inaccessible except in libraries, and some of these are so voluminous as to make obscure much information on particular subjects sought by investigators. The book describes the work carried on in the antitoxin and vaccine laboratory, further measures to protect the public health, protection of the food supply, the Lawrence Experiment Station and the State House Water and Sewage Laboratories, engineering work, and many other topics that have to do with the health of the public. Those desiring information on subjects dealing with public health will find an invaluable aid in this book.

Catalog Notes

ACORN DIES are illustrated and price lists are given in a pamphlet just received from Greenfield Tap and Die Corporation, Greenfield, Mass.

SYNCHRONOUS MOTORS, manufactured by Electric Machinery Co., Minneapolis, Minn., are described and illustrated in a recent bulletin, No. 168.

ROBERTSON DRY SYSTEM oil purifiers are illustrated in round type and in vertical and horizontal rectangular types in a folder recently issued by John F. Robertson Co., of Pittsburgh, Pa.

BULLETIN B-2, of Combustion Engineering Corporation, New York, contains a number of new illustrations showing the application of Type "E" stokers under various types of boilers.

STEAM AND POWER DRIVEN air compressors, Classes A-E and B-E, made by Nagle Corliss Engine Works, Erie, Pa., are illustrated and described in that company's Bulletin No. 27.

THE IDEAL DRIVE for Textile Machinery is the title of Book No. 258 of Link-Belt Co., 39th St. and Stewart Ave., Chicago. This book describes Link-Belt Silent Chain Drive and illustrates its operation in factories.

"STEAM BOILERS and How to Rid Them of Scale, Pitting and Corrosion," is the title of a booklet issued by The Boiler-Kote Co., of Chicago, Ill., stating what this treatment is, how it operates in the boiler, and giving full directions how to use it.

FROM INGERSOLL-RAND CO., 11 Broadway, New York, we recently received Form No. 9024 relating to Beyer barometric counter-current type steam condensers. A discussion of the principles underlying steam condensing is given, and relative merits of the several available types of condensers are set forth.

SPRAGUE ELECTRIC monorail hoists, cage controlled, are described and illustrated in Bulletin No. 48,700a, superseding Bulletin No. 48,700 of Sprague Electric Works of General Electric Co., New York.

Another new bulletin, B-3429, describes motor driven ventilating fans made by that company.

THE STROH PROCESS, a method for casting the finest alloy steel together with ordinary soft steel in one solid piece, is explained in an illustrated catalog just issued by Stroh Steel-Hardening Process Co., Pittsburgh, Pa.

BUYING A CAUSE and Paying for Effect is the title of a booklet published by The Society for Electrical Development, Inc., 29 W. 39th St., New York. Following the development of the main idea, Selling Illumination, there is a chapter on How to Sell, one on Factory Illumination, and illustrations from photographs of well-lighted shop windows. The book concludes with a bibliography listing the various books and articles which have been published in the industry on the subject of good lighting.

A NEW BOOKLET, "On the Trail of Byers Pipe," has just been issued by A. M. Byers Co., Pittsburgh, Pa. This gives the record of pipe which has been installed from 25 to 45 yr. in plumbing, heating, gas and power installations, showing the buildings where such installations have been in use, and the record made in these buildings. They are located in large cities all over the country, and the booklet thus enables anyone interested in the subject of piping to ascertain details about the service of genuine wrought-iron pipe at first hand and under various conditions. A copy will be sent to any engineer by the A. M. Byers Co. on request.

A 24-PAGE BULLETIN, No. 45,601-A, on Aluminum Lightning Arresters for Alternating Current Circuits, is being distributed by the General Electric Co. This bulletin supersedes Bulletin No. 45,601, and contains valuable data and diagrams on this installation. The aluminum type of lightning arrester owes its protective qualities chiefly to the "Valve" action of the aluminum cell which has the property of opposing the flow of current, like a high resistance, at the normal operating voltage, and of allowing a free flow at abnormal voltages due to lightning or similar disturbances. A close analogy to this action is found in the safety valve of the steam boiler, by which steam is confined until the pressure rises above a certain value, when it is released.

AMONG THE PUBLICATIONS recently issued by the Westinghouse Electric & Mfg. Co., are the following:

Self-Contained Vertical Shaft A.C. Generators, leaflet 3555-A, describing by means of diagrams and photographs, the construction of this type of generators, particular attention being given to the Kingsbury thrust bearing used therein.

A.C. Motors for driving Grinders, leaflet 3903. The particular features of the motor adapting it for this type of work are emphasized and illustrated.

Leaflet 3927, The Automatic Operation of Induction Feeder-Voltage Regulators. This is a comprehensive treatise on this subject representing the latest developments in this type of apparatus, the demand for which has been very great during the past several months.

Electrical Arc Welding Equipments, leaflet 3668-B, describing the equipment furnished for arc welding, and explaining and illustrating the various places in which this form of weld may be successfully applied.

PRACTICAL ENGINEER

Trade-mark, Reg. U. S. Pat. Off.

PUBLISHED THE FIRST AND FIFTEENTH OF EACH MONTH

SEMI-MONTHLY

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All copy should be received at Chicago office 18 days before date of publication.

Circulation of this issue, 22,000.

Technical Publishing Co.

537 S. Dearborn Street

Chicago

Position Wanted

POSITION WANTED—By man 33 years of age, good habits, with 6 years' experience with steam and gas engineering. Best of reference. Ohio license. Would prefer position in western or southern states. Address Box 482, Practical Engineer, 537 S. Dearborn St., Chicago. 7-1-1

POSITION WANTED—By a practical engineer with over 20 years' experience. Have I. C. S. Diploma. Can furnish best of references. Prefer Illinois or Missouri. Address J. M. B. Shanks, Dixon, Mo. 7-15-1

POSITION WANTED—By Producer Gas Engineer, thoroughly familiar with A. C. or D. C. current; also refrigeration. Nine years' experience. Age 27. Married. A1 references. Address R. D. Furness, Maple Ave., Peekskill, N. Y. 7-15-1

POSITION WANTED—Young man wishes position as oiler or assistant to the engineer in a plant around New York City. Two years' practical experience. Address Frank Demartini, 30 Mulberry St., Yonkers, N. Y. 7-15-1

POSITION WANTED—As engineer in small steam plant not over 125 H. P., by young man. Steady and sober habits. More than 5 years' experience as engineer in grain elevator. Good mechanic. Address Box 123, Dixon, Ia. 7-15-2

POSITION WANTED—By a young man as oiler or assistant engineer in a plant where there is a chance for advancement. Three years' practical experience. Ready to tsart work at a week's notice. Address Wm. Wykes, 304 Palisades Ave., Yonkers, N. Y. 7-15-1

POSITION WANTED—As chief engineer. Have had 10 years' practical experience. Especially qualified to handle the plant on an effiency basis, reducing coal consumption and operating costs. Must locate in Chicago. Presently employed, but have good reasons for desiring a change. Address Box 479, Practical Engineer, 537 S. Dearborn St., Chicago, Ill. 6-1-1

POSITION WANTED—By steamfitter with 17 years' experience at the trade. Can furnish references as to habits and ability to handle men. I am 33 years old. Married. Address J. H. D., 669 Wunderlick St., Barberton, O. 6-15-1

POSITION WANTED—By thoroughly competent man with 11 years' experience as engineer and assistant superintendent in sugar factories in Cuba, Mexico and Louisiana. Good steamfitter and machine repairman. Have had charge of 10 steam boilers and 6 ammonia compressors as day and night engineer. Can speak English, Spanish and some German. Single. 26 years old. Can furnish good references. Address Box 480, Practical Engineer, 537 S. Dearborn St., Chicago. Ill. 6-1-2

POSITION WANTED—Young man, age 28, as engineer in New York or Brooklyn. Hold marine, stationary and refrigeration license. Day work, 8-10 hours, desires to go to school nights. Write for particulars. Box 452, Practical Engineer, 537 S. Dearborn St., Chicago, Ill. 5-1-4

POSITION WANTED—As oiler, by young man, age 21, single. Willing to accept position in any city. Address Peter Stanys, 670 W. 18th St., Chicago, Ill. 6-1-1

POSITION WANTED—As fireman or oiler in large plant; 3 years' experience as fireman, 18 months as assistant engineer. Married. Strictly sober. Prefer Southern States. L. C. Drake, Cambridge City, Ind. 6-15-1

POSITION WANTED—As chief engineer in industrial plant, Missouri, Arkansas, Kansas, Iowa or Nebraska, or as Superintendent of light and water plant in city of 2500 to 8000. Ten years' practical experience with steam, electrical and water systems. Technical training. Now employed by U. S. Government as engineer and instructor. Executive ability. Can report on 15 to 30 days' notice. Married. Age 30. Address Practical Engineer, Box 466, 537 S. Dearborn St., Chicago Ill. 6-1-1

POSITION WANTED—By young man, 23 yrs. old, as fireman or oiler in ice or electric light plant in City of St. Louis. Have had one years' experience in firing and some experience in steam engineering. Address Leonard Ochs, 1536 Papin St., St. Louis, Mo. 6-1-2

POSITION WANTED—By engineer: have Ohio engineers' and boiler inspectors' licenses. Experienced with absorption method of manufacturing gasoline. Good references. Address Box 481. Practical Engineer, 537 S. Dearborn St., Chicago, Ill. 6-1-2

Help Wanted

WANTED—Resident subscription agents in the following cities: Atlanta, Ga.; Cincinnati and Columbus. Ohio; Kansas City, Mo.; Los Angeles, Cal.; Louisville, Ky.; Newark, N. J.; New Orleans, La.; Portland, Ore.; St. Louis, Mo.; San Francisco, Cal.; Washington, D. C. This is an excellent chance for a hustler who is familiar with power plant conditions, to turn his spare time into dollars. To such a one we offer a Real Opportunity. Write Subscription Department, Practical Engineer, 537 S. Dearborn St., Chicago, Ill. tf.

Wanted

WANTED—Agents on commission to sell our shaking grates. We will install grates on trial or put it to test at our expense with any grate made. Address Armstrong Mfg. Co., Springfield, Ohio. tf.

WANTED—Agents handling engine and boiler room specialties in every section for side line paying large commissions. Give experience, line carried and territory covered. Box 381, Practical Engineer, 537 S. Dearborn S', Chicago, Ill. tf.

WANTED—Marine boilers. We will pay cash awards for information that leads to a purchase by us of marine boilers of from 75 H. P. to 250 H. P. The Pittsburg Boiler & Machine Co., Pittsburg, Kansas. tf.

For Sale

NEED MORE POWER?—Get it without additional fuel; modern Green Standard Economizer, little used, 32 sections, 8 tubes each, 3073 sq. ft., with scraper engine, gearing, valves, soot doors, castings, dampers—subject to Hydrostatic test—immediate shipment. Also 14x42 Corliss Engine, double eccentric and 150 hp. Closed Heater, both nice condition. All subject to examination and price sale. Myron E. Whitman, Powers Building, Rochester, N. Y. 7-15-1

BOILERS—260 H. P. Babcock & Wilcox water tube boiler, 150-lb. pressure, $1250; 260 H. P. Sterling ditto, $1250; 16x36 Fishkill Corliss engine, entirely overhauled, $600; 15x14 Ideal automatic engine, $400. Power Machinery Exchange, Jersey City, N. J. 7-15-1

Patent and Patent Attorneys

PATENTS THAT PROTECT AND PAY—Advice and books free. High references. Best results. Promptness assured. Send sketch or model for search. WATSON E. COLEMAN, Patent Lawyer, 624 F St., N. W., Washington, D. C. tf.

PATENTS—C. L. Parker, Attorney-at-Law and Solicitor of Patents. Patents secured promptly and with special regard to the legal protection of the invention. Handbook for inventors sent upon request. Washington, D. C. tf.

PATENTS—H. W. T. Jenner, Patent Attorney and Mechanical Expert, 606 F St., Washington, D. C. Established 1883. I make a free examination and report if a patent can be had and the exact costs. Send for full imformation. tf.

A. P. CONNOR, Consulting Electrical and Mechanical Engineer, Attornoy-at-Law and Solicitor of Patents and Trade-Marks. Results guarnteed. 121 Carroll St., S. E., Washington, D. C. tf.

PATENTS—Send sketch for free search and reports. Books and patents and book of reference letters sent free. John S. Duffie & Co., 612 F St., Washington, D. C. tf.

PATENTABLE IDEAS WANTED—Send for three free books. R. B. Owen, 28 Owen Bldg., Washington, D. C. tf.

Technical Books

FREE ENGINEER BOOKS and power plant tools and specialties, for securing new subscribers for Practical Engineer. A dandy chance for the engineer with a little spare time to get some fine premiums. Send for free descriptive circular and terms. Subscription Department, Practical Engineer, 537 S. Dearborn St., Chicago, Ill.

Miscellaneous

ENGINEERS, DO YOU WANT to utilize your exhaust steam for heating or drying purposes without back pressure on your engine? If so, address Monash Engineering Co., 1413 Jackson Blvd., Chicago, Ill. tf

Sparks From The Advertising Pages

Advertising Is Not a Waste

Figures given out by the Association of National Advertisers Show Low Percentages of Advertising Costs when Compared with Gross Receipts.

"Let us see how much the big advertisers spend," says Alan C. Reiley, President of the Association of National Advertisers, in discussing this matter. "The average man hears talk every day about the millions and millions spent for advertising and he finally gets the notion that somehow or other the buyer has got to pay for it.

"I wonder if Mr. Average Man ever stops to realize that those millions spent in advertising sell hundreds of millions worth of goods—goods that could never be sold so cheaply in any other way. And it is this immense saving in selling cost that helps to make lower priced goods.

"Millions spent for advertising sounds big, but 'hundreds of millions worth of goods sold by advertising' makes the actual amount spent for advertising look small.

"What is the exact ratio of advertising to sales anyhow? This is something that every buyer would like to know.

"I am glad to be able to tell the public. The Association of National Advertisers has collected some valuable facts and figures on this subject. Listen to a few of them.

"The advertising of one of the leading paint manufacturers of the country averages $3\frac{1}{3}$ per cent of their total sales. In other words, for every dollar's worth of paint they sell, they spend $3\frac{1}{3}$ cents in advertising. This is about equivalent to the price of a postage stamp and a cent's worth of paper for every dollar's worth of goods sold. Another big paint and varnish manufacturer spends from $3\frac{1}{2}$ to $4\frac{1}{2}$ per cent.

"Next take clothing. We have obtained figures concerning two of the biggest clothing manufacturers in the country. One spends $1\frac{1}{2}$ per cent; the other 2 per cent. An equally prominent shoe manufacturer spends $1\frac{1}{2}$ per cent.

" 'But shoes and clothing are necessities,' you may say. 'How about the luxuries?' "

"All right! Take one of the most popular luxuries in the world—candy. One of the best known candy makers in the country and one of the biggest advertisers, spends 5 per cent.

"Then take the big automobile and tire manufacturers with their full page and double page spreads. Surely now the percentage figures will begin to jump. Will they?

"You will be surprised when I give you the figures for two of the most famous automobile builders in the country. One is 2 per cent; the other is 3 per cent. Also two of the leading tire manufacturers; one spends 2 per cent; the other 2 per cent. And all four rank among the biggest advertisers in the country.

"These figures are authentic, and when you consider the enormous volume of the automobile and tire business you will see that the small percentages are ample to provide for the wonderful publicity.

"And then we come to the big department stores—where at one time or another every buyer buys. You can see them fairly eating up the newspapers with their big spreads. But if you expect to find big percentage figures here again you will be agreeably disappointed. The figures possessed by the Association of National Advertisers show that the average department store's advertising does not cost more than 3 per cent of its total business.

"The fact is that the great majority of all nationally-advertised articles—articles which are familiarly known in every home in the country, which are famous for their quality as well as their immense distribution, belong in the 5 per cent or under class.

"And let this final point be remembered. Even if advertising represented a direct advance on what the buyer would otherwise have to pay, this would make little difference in the price of the goods. But it does not. And why not?

"Because advertising is the most efficient method of marketing ever developed by business enterprise—therefore its effect is to decrease and not to increase the sum total of selling cost. This is a simple fact about advertising that every buyer of advertised goods ought to know."